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ASIATIC SOCIETY OF BENGAL,

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"It will flourish, if naturalists, chemists, antiquaries, philologers, and men of science in different parts of *Asia*, will commit their observations to writing, and send them to the Asiatic Society at Calcutta. It will languish if such communications shall be long intermitted; and it will die away, if they shall entirely cease."—

SIR WM. JONES.

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1859.

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JOURNAL

OF THE

ASIATIC SOCIETY.

No. I. 1858.

Discussion of some Meteorological Observations made on Parisnath Hill, by Dr. G. von Liebig.

The following discussion of a few Meteorological observations made on the Parisnath Hill in 1856, I submit to the Society less because they contain any new facts, than with a view of drawing attention to the peculiar advantages offered in India for the investigation of meteorological questions by the great regularity of all atmospheric changes. A few days observations in this country will suffice to trace laws, the exhibition of which would, in Europe, require months and years of continued observation.

I would particularly wish to exhibit the use of conveniently situated stations, in different elevations, one above the other, as calculated to study the changes affecting the whole of the atmospheric strata between them.

Parisnath hill is situated nearly 200 miles to the North West of Calcutta, close to the Trunk road. The hilly country begins about 120 miles from Calcutta, near Raneegunge, and the general level, proceeding to the North West, is gradually raised. When the trunk road reaches the base of Parisnath hill, its level is about 900 feet above that of Calcutta. The hills between Raneegunge and Parisnath are not continuously connected with each other, they form no chain, but partake more of the character of isolated elevations, leaving tracts of open and undulating country between them.

Travelling to the North West, the hill is on the right of the Trunk road. Its crest runs from East and a few degrees South to the West and a few degrees North. Its highest points are at both ends, the first and higher one on the western, the second and lower one on the eastern termination; the distance between them is about a mile and a half. Midway and to the South of a straight line drawn between them is a third summit lower than either of the others, but differing very little from the second. This is a trigonometrical station, and its height, as taken from the revised calculations of the Records of the Calcutta longitudinal series is 4477.73 feet above the sea, or 4459.62 feet above the level of Calcutta. These three summits are connected by a slightly undulating ridge, the crest of the hill, on both sides of which the ground immediately begins to slope downwards, leaving only a narrow strip of ground to walk upon.—Immediately below the eastern or second summit, descending about 430 feet on the southern slope, stands, on a partly artificial base a small Jain temple, in the open verandah of which most of the barometrical observations were made. It is protected towards the North by the side of the hill, which is very steep and towards the East by a spur branching off from the summit above. Towards the South and the South West the view is open, but towards the West it is hemmed in by protruding masses thrown out from the centre of the hill.

Observations. The observations were made on the 1st, 2nd, 3rd and 4th of April, 1856. On the 4th I left the hill, and the last two observations on that day were made in the travellers Bungalow at Topchancee, a village near the foot of the hill.

On the hill during the first three days the sky was cloudless, with the exception of a few occasional stratus-clouds in the South West, and the atmosphere, in the middle of the day was hazy and not very transparent. The wind on the summit was a breeze from the North West. On the morning of the 4th, white clouds from the South were travelling northward; about midday they became very dense and formed a good protection against the sun.

In Calcutta, from the 1st to the 3rd, the sky was clear and the wind from the South and South West. On the 4th, the southerly breeze was stronger than on the preceding days, and during the day the aspect of the sky was cloudy.

It appears that from the 1st to the 3rd, the southerly wind, which was at first only observed at Calcutta, had, gradually progressing, replaced the North Westerly breeze at Parisnath, the change having been completed on the 4th.

The barometer used on the hill was a mountain barometer by Adie, suspended in a tripod, which had been compared with the standard barometer of the Calcutta Observatory; before each reading, the surface of the mercury in the cistern had to be adjusted to the scale. All observations, with the exception of those on the summits, were taken in the open verandah of the temple. The instrument, to avoid the sun, had to be carried from one part of the verandah to the other, several times during the day.

The thermometers were centigrade; they had not been compared with the standard of the observatory, but with another reliable standard. The temperature of the air was measured in the shade of a small tree on the North side of the temple, between it and the hill side, a place, which was little accessible to the direct rays of the sun, but where the air circulated freely.

A few observations with the wet bulb thermometer were made on the 2nd and 3rd April.

The Calcutta observations have been obtained through the kind permission of Major Thuillier from the Register of the Observatory, where observations are taken every hour.

The following table gives the readings of the barometer and thermometer on the hill, and those at the corresponding hours at Calcutta. The barometrical readings of both places are corrected for temperature and those of the hill also for the standard barometer of the Observatory. The thermometrical readings are also corrected.

I.—Table of

	1st April.						2nd April.				
Time.	Temple.		Second Summit.		Calcutta.		Time.	Temple.		Calcutta.	
h. m.	Bar.	Ther.	Bar.	Ther.	Bar.	Ther.	h. m.	Bar.	Ther.	Bar.	Ther.
6	25.963	21.6			29.850	25.7					
,, 30	..	..			..	..					
7	25.980	21.9			29.875	26 0			22.3		25.7
,, 40	25.999*	22.5*	25.611	21.4	29.892*	27.2*					
8	26.009*	22.6*			29.900	27.7					
,, 15	26.016	22.9			29.903*	28.1*					
9	26.032	23.1			29.913	29.1	9				
,, 30	26.042	23.8			29.915*	30.0*	,, 15	25.992	23 9	29.880	30.1
10	26.044	24.5			29.918	30.9	10	..	..	..	
....	..	..			..	..	,, 15	26.002	24.3	29.877	31.8
11	26.040	25.8			29.902	32.1					
Noon	26.021	27.2			29.880	34.0					
1	26.006	28.1			29.842	34.5					
2	25.973	29.1			29.806	35.6					
3	25.951	28.0			29 787	36.1					
4	25.928	27.3*			29.772	36.1	4				
,, 40	..	..			29.765*	35.5*	,, 55	25.885	27.1	29.716*	35.6*
5	..	26.6*	25.553	25.4	29.762	35.2	5	25.884*	27.0*	29.715	35.5
,, 25	25.942	26.3			29.762*	34.4*		..	..	..	
6	25.957	25.0			29.763	33.1	6	25.885	25.7	29.716	33.3
7	..	24.8*			29.779	31.3					
8	25.964	24.6			29.796	30.0					
	..	..			..	..					
	..	..			..	..					
	..	..			..	..					
	..	..			..	..					

Interpolation.—All observations in the table marked with a star, are interpolated. This was done graphically on paper, lithographed for the purpose. A horizontal and a vertical system of straight lines, crossing each other, formed a network of accurately drawn minute squares, each of one millimetre side. By means of this network the barometric curve could be designed on any convenient scale, and where the interval of time between two observed points was not greater than one or two hours, a straight line, connecting

Observations.

	3rd April.						4th April.			
Time.	Temple.		Highest Summit.		Calcutta.		Temple.		Calcutta.	
h. m.	Bar.	Ther.	Bar.	Ther.	Bar.	Ther.	Bar.	Ther.	Bar.	Ther.
6	..	..			..	..	25.894	19.3	29.778	27 2
„ 30	..	..			..	..	25.905	20.8	29.786*	27.3*
7	..	..			..	..	25.909	20.9	29.795	27.4
„ 40	..	..			..	..	..	..	..	..
8	25.944	22.6			29.816	28.7	25.928	21.6	29.811	28.5
„ 15	..	..			..	..	..	..	..	..
9	25.916	24.0			29.837	30.1	25.952	25.1	29.831	29.7
„ 30	..	..			..	..				
10	25.972*	25.9*			29.849	31.7				
„ 10	25.971	26.2			29.847*	31.9*				
11	25.968*	27.0*			29.836	33.2				
Noon	25.960*	28.0*	25.508	25.5	29.816	33.9				
1	25.935*	29.0*			29.781	35.0	Top chancee.			
2	25.903	30.0			29.740	36.1	28.817	35.0	29.733	34.1
3	25.872	29.8			29.712	36.3	28.794	34.6	29.713	33.9
4	25.856	29.0			29.701	36.0				
„ 40	..	..			..	..				
5	25.849	28.1			29.691	34.7				
„ 25	..	..			..	..				
6	25.852	26.6			29.698	32.3				
7	25.860*	26.2*			29.705	31.0				
8	25.872*	25.7*			29.726	29.5				
„ 30	25.885	25.5*			29.740*	29.1*				
9	25.893	25.2			29.754	28.7				
„ 30	25.903	25.2			29.762*	28.6*				
10	25.907	25.3			29.770	28.5				

them, gave the reading of the intermediate smaller divisions of time. Where the interval was greater, a knowledge of the shape of the curve at the particular time of the day was employed in drawing the connecting piece of the curve. This method of interpolation could only be followed with a sufficient approach to correctness, where the curve did not deviate much from a straight line. The only instance of the interpolation of a larger interval was that of the hours 11, noon and 1 on the 3rd, and it will be seen further on,

that the interpolated values could not have differed from the real ones more thau the unavoidable smaller errors of observation might have amounted to.

The temperatures were interpolated in a similar manner.

The curves Fig. 1 and 2 in the plate graphically represent the hourly changes of the barometer, the first at Calcutta where the observations were complete for the 24 hours, and the second on Parisnath hill.

In constructing the curve of the hill, the hours after 4 P. M. on the 1st have uot been included. Their readings are indicated by dots in the figure. The general regularity of all other parts of the curve in themselves as well as with reference to the Calcutta curve, and the absence of disturbing influences in the atmosphere at the time, justify a conclusion that the observations of the hours iu question should not have formed an exception to that regnlarity. Taking into consideratiou some other external circumstances, accompanying these observations, which could have contributed to make them uncertain, and no data being available for correcting them, they were rejected. Their evidence goes ouly so far with certainty as to show the turning of the curve in the evening betweeu 4 and 5 P. M. The observations of the 2nd April could also be used only for general conclusions. The first, at 9 h. 15 m. A. M. is evidently erroneous, as will be seen further on, from the curve of real mean temperatures.

The observations on Parisnath hill were made by Calcutta time. The difference in Longitude between Calcutta and Parisnath is 2° 29′ 23″ which would correspond to betweeu 9 and 10 minutes time. This differeuce is so small that it would produce no sensible effect upou the barometrical hours, aud its influence may therefore be neglected in comparing the observatious at both places with each other.

I shall now enter upon a closer examination of the observations made on the 1st, 3rd and 4th April, omitting those of the 2nd and also the barometric readings of the hours after 4 P. M. on the 1st, retaining however the temperatures of these hours.

Barometric Curves.—The barometric readings for the full hours are giveu in the following table:—

Table II.—Hourly Barometric Pressures.

	1st April.			3rd April.			4th April.		
Time.	Temple.	Calcutta.	Diff.	Temple.	Calcutta.	Diff.	Temple.	Calcutta.	Diff
6	25.963	29.850	3.887	..	29.771	..	25.894	29.778	3.884
7	25.980	29.875	3.895	..	29.785	..	25.909	29.795	3.886
8	26.009*	29.900	3.891	25.944	29.816	3.872	25.928	29.811	3.883
9	26.032	29.913	3.881	25.961	29.837	3.876	25.952	29.831	3.879
10	26.044	29.918	3.874	25.971	29.847**	3.876			
11	26.040	29.902	3.862	25.968*	29.836	3.868			
Noon	26.021	29.880	3.859	25.960*	29.816	3.856			
1	26.006	29.842	3.836	25.935*	29.781	3.846			
2	25.973	29.806	3.833	25.903	29.740	3.837			
3	25.951	29.787	3.836	25.872	29.712	3.840			
4	25.928	29.772	3.844	25.856	29.701	3.845			
5	..	29.762	..	25.849	29.691	3.842			
6	..	29.763	..	25.852	29.698	3.846			
7	..	29.779	..	25.860*	29.705	3.845			
8	..	29.796	..	25.872*	29.726	3.854			
9	..	29.813	..	25.893	29.754	3.861			
10	..	29.823	..	25.907	29.770	3.863			

** In this and the following tables the place opposite the hour of 10 A. M. on the 3rd is always occupied by the reading obtained at 10 h. 10 m. This hour had been observed on the hill and was easily interpolated for Calcutta.

The most striking feature of the barometrical curves is their great regularity. The shape of the curve of one day is like that of the next, and the transition from hour to hour is as gradual and imperceptible, as if we had before us the means of a month or a year, instead of having the observations of only a single day.

The pressure is falling without interruption at both stations on the 1st, 2nd and 3rd April. The following are the mean pressures on each day at Calcutta and on the 1st and 3rd on the hill. Those at Calcutta were taken from the hourly observations of the Observatory, those on the hill were derived by the combination of hours

$\frac{\text{VIII. } a + \text{IV. } p. + \text{I. } p. + \text{II. } p.}{4}$ which gives, for Calcutta, a tolerably good approximation to the mean.*

Mean daily pressure.	1st.	2d.	3d.	4th.
Calcutta,.....	29.830	29.789	29.758	29.759
Hill, ...	25.979	——	25.909	——
Difference, ...	3.851		3.849	

The rate of falling was about the same at both stations. This diminution of the pressure was doubtless connected with the change in the wind during the same period, the current from the South or South-west displacing the North-westerly breeze.

It is seen from the table or the figures that the turning points of both curves during the day fall within admissible small limits, upon the same hours, and we may infer from the direction of the curve on the hill, in such places, where it is interrupted, that the maxima and minima during the night would have shown the same coincidence, had they been observed. The curve of the hill differs in so far from the Calcutta curve, as it is flatter, the extent of its daily variation being smaller. In the figure, the parts of the curve between the hours at which the observations had been interrupted, have been filled up with dotted lines for no other purpose, than better to define the position of such parts as had been observed. The readings substituted for the unobserved hours and also the manner in which they have been obtained, are given in the appendix.

The great regularity of the barometrical curves and the coincidence of their turning points, promising an equal regularity in all other atmospheric changes during the same period, has encouraged me to make the attempt to complete such data as were wanting in the small number of observations at my disposal, with a view of obtaining a complete picture of the atmospheric processes on the 1st and 3rd of April. Obliged as I have been in doing so, to have recourse once or twice to more or less conjectural estimations, the

* The means derived by this combination are generally about 0.006 inches too low. For the month of April, 1856, it differs — 0.004.

The means of the four days from the 1st to 4th April, derived by the combination for Calcutta, are

Mean daily pressure.	1st.	2nd.	3rd.	4th.
Calcutta,.....	29.830	29.793	29.759	29.751
Difference, from real daily mean,	0.000	+0.004	+0.001	—0.008

result has proved that they did not exceed the limits within which direct observations might have been equally liable to deviation.

Temperature.—The following table contains the hourly temperatures observed at both stations on the 1st, 3rd and 4th April:—

Table III.—Observed Temperatures.

Time.	1st April.				3rd April.				4th April.			
	I. Temple.	II. Calcutta.	III. Diff.	IV. Mean.	I. Temple.	II. Calcutta.	III. Diff.	IV. Mean.	I. Temple.	II. Calcutta.	III. Diff.	IV. Mean.
6	21.6	25.7	4.1	23 6	21.3**	26.0	4.7	23.6	19.3	27 2	7 9	23.2
7	21.9	26.0	4.1	23.9	..	26.7	..	..	20.9	27.4	6.5	24 1
8	22.6*	27.7	5 1	25.2	22.6	28.7	6.1	25.1	21 6	28.5	6.9	25.0
9	23.1	29.1	6.0	26.1	24.0	30.1	6.1	27.0	25.1	29.7	4.6	27.4
10	24.5	30 9	6.4	27.7	25.9*	31.7	5.8	28.8				
11	25.8	32.1	6.3	28.9	27.0*	33 2	6.2	30.1				
Noon	27.2	34.0	6.8	30.1	28.0*	33.9	5.9	30.9				
1	28.1	34.5	6 4	31.3	29.0*	35.0	6.0	32.0				
2	29.1	35.6	6 5	32.3	30.0	36.1	6.1	33.0				
3	28.0	36 1	8.1	32.0	29.8	36.3	6.5	33.0				
4	27 3*	36.1	8 8	31.7	29.0	36.0	7.0	32.5				
5	26.6	35 2	8.6	30.9	28.1	34.7	6 6	31.3				
6	25.0	33.1	8.1	29.0	26.6	32.3	5.7	29.4				
7	24.8*	31.3	6.5	28.0	26.2	31.0	4 8	28.6				
8	24.6	30.0	5.4	27.3	25.7*	29.5	3.8	27.6				
9	..	28 9	..	..	25.2	28 7	3.5	26.9				
10	24.2**	28.5	4.3	26.3	25.3	28.5	3.2	26.9				
Mean of 24 hours.	24 4	30.1	5.7	27.3	25.4	30.4	5.0	27.9				

** The temperatures for these hours have been estimated.

The maximum heat at both stations is a little higher on the 3rd than on the 1st; the hours of the maximum are 2 P. M. on the hill and 3 P. M. at Calcutta.

The mean temperature from all observations of the 24 hours at Calcutta is for the 1st 30°.1, and for the 3rd 30°.4. With these the values derived by the combination $\frac{\text{VI. a.} + \text{X. a.} + \text{IV. p.} + \text{X. p.}}{4}$, which gives very good means for many parts of India, closely agree; they are 30°.3 for the 1st, and 30°.5 for the 3rd April. In employing this combination for the hill, where the observations extend over only a part of the 24 hours, the temperatures for 10 P. M. on the 1st and for 6 A. M. on the 3rd, had to be estimated by analogy. This is certainly a very imperfect method, but it may be admitted in the present case, as the general state of the atmosphere was the same on both days; and the limits are so well defined, that the error can hardly amount to more than about half a degree, which divided by 4 becomes still more diminished. The estimated temperatures are put down opposite these hours in the table. The daily means derived in this manner for the hill are on the 1st 24°.4 and on the 3rd 25°.4.

The hour in the morning of which the temperature approaches nearest to the mean of the whole day falls between 9 and 10 A. M. at Calcutta, and at 10 A. M. on the hill.

The differences between the hourly temperatures at Calcutta and the hill on the 1st and 3rd (Cols. III.) are smallest in the morning and evening and increase towards 4 in the afternoon, when they reach their maximum on both days: 8°.8 on the 1st and 7° on the 3rd. The variation during the night has not been observed. On both these days the variation progresses with great regularity towards the maximum, but on the 4th it begins less regular, owing, doubtless to the formation of clouds on that day.*

Column IV. in the table gives the hourly means, computed from the observations at both stations; their curve is represented in fig.

* I have reason to suspect that the temperature observed on the hill at 9 on the 4th is too high. It was taken after the thermometer had been removed from the sheltered spot described above, previous to its being packed up for leaving the hill.

3. Here, the maximum on the 3rd is also a little higher than on the 1st; it occurs at 2 P. M. on the 1st; while on the 3rd the temperature at 3 is the same as at 2 P. M.

Taking the values obtained for the means of the whole day at each station, 30°.1 and 24°.4 on the 1st, and 30°.4 and 25°.4 on the 3rd, the daily mean temperatures for the air between the stations will be 27°.3 for the 1st, and 27°.9 for the 3rd, showing a difference of 0°.6. The combination $\frac{\text{VI. a.} + \text{X. a.} + \text{IV. p.} + \text{X. p.}}{4}$ applied to the hourly means, will give very nearly the same results, viz., 27°.6 and 27°.9. The temperature at $9\frac{1}{2}$ A. M. approaches nearest to the mean temperature of the 24 hours on both days.

The hourly means, derived from the observations at both stations are supposed to represent the mean temperatures of the stratum of air extending between the two stations, and they enter as such into the calculation of the height. It is well known that they have not, in reality, that signification, and to distinguish them from the real mean temperatures, I shall speak of them, in the following pages, as the mean temperatures of the stations.

Height.—The height of the temple and the summits was calculated by Gauss's formula, with the corrections for the decrease of gravity by latitude and elevation. The results in English feet, are arranged in the following table by the hours.

Table IV.—Difference of Height between

	Calcutta and the Temple.			The Temple and		Calcutta and	
				Second Summit.	Highest Summit.	Second Summit.	Highest Summit.
Time.	1st April.	3d April.	4th April.	1st April. 7 h. 40 m.	3d April. 12 Noon.	1st April 7 h. 40 m	3d April. 12 Noon.
				A. M.		A. M.	
6	4009.5	..	4010.7	429.4	510.5	4452.0	4585.1
7	4019.2	..	4023 7	4 h. 40 m.		4 h 40 m.	
8	4029.5	4027.1	4031.3	P. M.		P. M.	
9	4029.7	4049.0	4058.4	422.5		4494 3	
10	4044.5	4076.8*					
11	4051 6	..					
Noon.	4075.4	4086 5					
1	4065.0	4095.6					
2	4082.1	4106.6					
3	4084.0	4115.7					
4	4090.2	4113.6					
5	..	4094.1					
6	4051.7	4070.6					
7	..	4056.1					
8	4009.3	4045.2					
9	..	4042.8					
10	..	4042.0					

Difference of Height between Calcutta and Topchanee.

4th April.

2 P. M. 935.1
3 „ „ 938.0

* The height opposite 10 A. M. on the 3rd was derived from the observation at 10 h. 10 m.

The resulting height becomes greater as the day advances and reaches its maximum at 3 and 4 P. M., about which time the difference between the temperatures of the two stations is also greatest. It decreases towards evening and is smallest about the time of the lowest observed temperature at 6 A. M. It is well known that the cause of this variation lies in the difficulty of obtaining at all hours the real value of the mean temperatures of the column or stratum of air between the two stations.

A solid body and generally the solid surface of the ground, cools and heats quicker than the air in contact with it. In other words, it becomes hotter and colder in the same space of time, if exposed to the same heating and cooling influences—the sun during the day or a clear sky at night. This does not necessarily affect the mean

temperature for a period of 24 hours, which might be the same for the air and the ground.

As the atmosphere receives the greater part of its heat not directly from the rays of the sun, but indirectly, from the surface of the ground, the change of the hourly temperatures of the air will follow the extremes of the ground more closely when it is in immediate contact with it, than when further removed from the surface. The temperatures observed at each station as well as the hourly means derived from both, will therefore show a greater daily and hourly variation, than those of the column or stratum of air between them would, if they could be observed. It is only in the means of the whole of the 24 hours, where the extremes of hot and cold compensate each other, that the mean temperatures of the stations can be supposed to agree with the real mean temperatures of the air.

If we assume the mean temperature of the whole day, as taken from the hourly observations at both stations to be the same, or nearly the same, as that which would be obtained from the real hourly mean temperatures of the whole mass of air between them, then the curve of the hourly means of the stations will, in consequence of its greater variation, rise higher above the line of the common mean temperature during the day and sink deeper below it during the night, than the curve of the real hourly mean temperatures.

These curves must cross each other twice during the 24 hours, once in the morning, and once in the evening. At the moment of crossing the temperature of both is the same, and if the temperatures and the pressures be then observed, the resulting height must be the true one.

To obtain from the results in the table the true height of the temple, it will be necessary to find in the curve of the hourly mean temperatures of the stations, the hours of which the temperature will coincide with the real mean temperature of the column of air between the stations.

It is at once apparent that this hour cannot be far distant from the hour which will show the mean temperature of the 24 hours, in the present case about $9\frac{1}{2}$ A. M.

The crossing will take place after $9\frac{1}{2}$, if the curve of real mean temperatures should reach its daily mean, which I have assumed to

be the same or nearly the same, as that of the stations, earlier than the curve of the stations. If later it will take place before $9\frac{1}{2}$.

Considering (Fig. 3,) the rapid ascent of the mean temperature of the stations from 6 A. M. to 2 P. M.—it rises in 8 hours to the same height, from which it takes 16 hours to descend again—and the necessarily retarded progress of the real mean temperature of the stratum of air from its lowest point to its highest, it becomes extremely improbable, that the latter, although its starting point at 6 A. M. is a little above that of the former, should at $9\frac{1}{2}$, after only 3 hours, have reached a higher point than the temperature of the stations.

If I therefore take 10 A. M. as the extreme limit in the direction of the rising temperature, this will probably be a little higher than would be strictly required. It now remains to find the limit on the side of the lowest temperature. 6 A. M. being the hour of the minimum of the day, is out of the question. The temperature at 7 A. M. having risen comparatively little above that at 6, is probably too low, but to make up for the transgression on the other side, I will fix upon 7 as the lower limit.* Among the results included between the hours of 7 and 10, the true height must be found.

To be certain, I have taken the mean between the heights at 7, 8, 9 and 10 on the 1st, 3rd and 4th, a combination, in which the higher and lower values would partly compensate each other. The observations were complete for these hours on the 1st April. On the 3rd, the hour of 7 and on the 4th the hour of 10 had not been observed. For each of these the mean of the values at the same hour on the two other days was taken instead.

The resulting height is 4039.3 feet.

I have stated that the trigonometrical station, which is very little lower than the second summit, directly above the temple, was 4459.62 feet above the level of Calcutta, by the Records of the Longitudinal Series. The second summit is, by an observation taken at 7 h. 40 m. A. M. on the 1st April, 429.4 feet higher than the temple, a result, which is probably a little too low. This added to the computed height of the temple, 4039.3 feet, would make the

* In Europe the best time for taking heights barometrically is between 8 and 9 A. M.

second summit 4468.7 feet above Calcutta, or 9 feet higher than the trigonometrical station. This can hardly differ much more than about 10 feet from the real height.

*Real Mean Temperatures.**—The real hourly mean temperatures of the stratum of air between the two stations, are found, by introducing into the Barometrical formula the known value of the height (H.) and the observed Barometrical pressure (b, b'). The shape of the equation will be this—

$$t + t' = \text{num} \left\{ \text{Log H} - c - \text{Log} \left\{ \text{Log} \frac{b}{b'} \right\} \right\} - 2\,a$$

where $t + t'$ stands for the sum of the temperatures of both stations. H, c and a are constant quantities for all hours. An error of 10 feet in the height of the temple (4039.3 feet) would cause a difference of about 0°.7 in the temperature of each hour, but it would not alter the character of the curve or the magnitude of the variation. The following table contains in the second column under each day, the real mean temperatures as obtained by the formula :—

Table V.—Real Mean Temperatures.

	1st April.			3rd April.			4th April.		2nd April.	
Time.	I. Observed Means.	II. Calculated.	III. Corrected.	I. Obseaved Means.	II. Calculated.	III. Corrected.	I. Observed Means.	II. Calculated.	I. Observed Means	II. Calculated.
6	23.6	25.6	..	23.6	..	..	23.2	25.2		
7	23.9	25.3	..	..	..	..	24.1	25.2		
8	25.2	25.9	..	25.1	26.5	26.2	25.0	25.5		
9	26.1	26.7	..	27 0	26 4	..	27.4	26.1	27.0	25.9**
10	27.7	27.3	..	28.8	26.5*	26.7			28.0	26.9**
11	28.9	28.1	.	30.1	27.0	27.1				
12	30.1	28.1	28.5	30.9	27.7	27.6				
1	31.3	29.7	29.2	32.1	28.1	..				
2	32.3	29.4	..	33 0	28.4	..				
3	32.0	29.0	..	33.0	27.9	28 0				
4	31.7	28.1	..	32.5	27.4	27.6				
5	30.9	..	..	31.3	27.5	27 4			31.2	28.8
6	29.0	..	..	29.4	27.3	..			29.5	28.6
7	28.0	..	..	28.6	27.4	27.1				
8	27.3	..	..	27.6	27.0	..				
9	..	..	..	26.9	26.7	..	* 10 h. 10 m.		** 9 h. 15 m. 10 h. 15 m.	
10	26.3	..	..	26.9	26.7	..				

* A. and H. Schlagintweit, Neue Untersuchungen, &c. &c. Leipzig 1854. Page 409.

The curve of the real hourly mean temperatures, Fig. 4, a. presents on the 1st and 3rd April some slight inequalities, which must be corrected, in order better to exhibit the real shape of the curve. We know that the ascent from the minimum in the morning to the maximum in the afternoon, must be gradual and continuous, uninterrupted by irregular and sudden deviations. The corrections will have to be regulated by the turning points of the curve, which it is therefore of importance to fix beforehand.

In a similar case* the maximum hour of the real mean temperatures of the air between the stations has been found, in a greater height, to fall after the maximum hour of the mean temperatures of the stations.

In the present case the shape of the curves of both days distinctly forbids us to look for the maximum after 2 P. M. On the 1st there is a doubt between 1 and 2 P. M., but on the 3rd the hour of 2 P. M. decisively predominates. The hour of 2 P. M. also preponderates in the hourly means of the stations, and, such being the case, theoretical reasons, as well as experience, speak strongly against the occurrence of the real maximum of the air between the stations before that hour. In the present instance the height of the stratum of air is so small, that a near coincidence of the hour of its maximum temperature with that of the maximum temperatures of the stations cannot be considered irregular, and we may safely admit the hour of 2 P. M. as that of the maximum temperature in the curve of the real hourly means.

The hour of the minimum, 7 A. M., which is clearly indicated as such on the 1st and not contradicted on the 4th, was not altered, as there are reasons, which will be mentioned further on, for considering a further slight decrease of the temperature of the air for a short time after sunrise, as a not unusual occurrence. The corrections were effected graphically, by adopting, wherever the continuous line was broken, a mean course between the deviations on either side, supposed to have been caused by the real mean temperatures having been found too high or too low. They are put opposite the respective hours in Col. III. of the table. On the 1st April only the hours 12 and 1 required readjustment, all others having been taken as correct.

* A. and H. Schlagintweit, K. c.

The mean temperatures of the 2nd have been inserted in the table, merely to show the reason for rejecting the barometrical observations of the hours of 9 h. 15 m. and 10 h. 15 m. A. M. made on that day on the hill. The parallelism of the real mean temperatures of these hours with those of the mean curve of the stations clearly indicates that one of the two readings must have been erroneous. The number of observations on that day is not sufficient to warrant an attempt at correcting them.

The curve of the 3rd April presents some difficulties, the temperatures at 8 and 10 A. M. are equal and both higher than that at 9. This arrangement could not by any means represent the true relation between them.

There being no direct and certain indications to guide us in selecting one of these temperatures as correct, which might then serve as a starting point in altering the other two, the following considerations decided me at last in favour of the temperature at 9.

It will be recollected from Table III. that the mean temperatures of the air between the stations for the whole 24 hours, as derived from the thermometric observations (Col. IV.), showed a difference of only 0°.6. Assuming that the real daily mean temperatures of the air on both days would differ rather less than more in the same or the opposite direction, from each other, and that, judging from observations made by others, they would fall later than the hour at which the daily means had been observed to fall in the curve of the mean temperatures of the stations, which was 9½ A. M., I have concluded that the difference between the real hourly mean temperatures of both days would be greater after that hour, in the hot part, than before it in in the cold part of the day. Guided by this supposition it might be expected that the real mean temperature of the hours 8, 9 and 10 on the 3rd, would differ comparatively little from those at the same hours on the 1st.

This was made still more probable, from the small range of the curves, which is less than half that of the curves of the stations.

The temperature at 9 on the 3rd 26°.4 (Table V. Col. II.) agreeing nearest, within the probable limits, with the temperature of the same hour on the 1st, 26°.7, I have taken it as the correct one.

Next the hours 1, 2, 6, 8, 9, 10 were considered correct and the remaining hours were altered as the table shows, (Col. III). Fig. 4 in the Plate represents the corrected curves.

On the 4th April no alterations were required.

Having adopted these corrections, I now proceed to point out the distinguishing features of the curves of real hourly mean temperatures, Table V. (Fig. 4).

In the first place they have a much smaller range than the temperatures derived from the observations (Col. I.) The range of the latter, on the 1st is 8°.7, on the 3rd it is 9°.5, whereas the range of the real means, between 7 and 2, is on the first only 4°.1, not quite half of that of the temperatures of the stations. On the 3rd, the barometer had not been observed at the hour of the minimum, but judging from the small hourly variation, the daily range on that day must have been still smaller than on the 1st.

It is not possible to arrive at a definite conclusion regarding the absolute real daily mean temperatures on both days; the possible error in the height and the error which might arise from different degrees of moisture on both days would make it uncertain. The relative values of the real daily mean temperatures as compared with each other, are also difficult to ascertain. The smallness of the number of observations hardly allows an estimate being formed from them. An estimation or interpolation for some of the deficient hours could not be made with the same reliance as in the instance of the mean curve of the stations, and the fitness of the combination of hours which had been employed before, would have been to say the least, doubtful.

As far as a conjecture may be permitted from the average hourly variation on the 3rd, the minimum temperature on that day could not have been more than about half a degree higher than that on the 1st. But the maximum temperature of the 3rd is a whole degree lower than that of the 1st, a difference of the same magnitude, but in an opposite direction as that between the maxima of the curve of the stations. If therefore the real daily mean temperatures of both days were not the same, the probability is, that the real mean temperature of the 24 hours on the 3rd was lower than that on the 1st. The case is the reverse as regards the daily mean

temperature of the stations, which on the 3rd is higher than on the 1st.*

The only consequence which could possibly be inferred from this would be, that on successive days the course of the daily mean temperatures of larger masses of air, removed from the ground, does not always proceed parallel to the daily means of the stations; the latter may be rising when the former are falling or remaining stationary, or the reverse.

In the present case, the small number of days and the omission of taking the moisture into account does not allow us to consider this result as an established fact; but the possibility of such an

* Such a result might have been predicted from the decrease in the barometrical pressure from the 1st to the 3rd. The height obtained by the barometric formula

$$H = C \operatorname{Log} \frac{b}{b'} (1 + \beta T)$$

(omitting the smaller corrections for gravity) depends mainly on the value of the quantity $\operatorname{Log} \frac{b}{b'}$. This value will increase, when the barometrical pressures decrease, if the difference between the latter, (b—b′) remains the same. In such a case, to obtain a constant value for the height, the mean temperatures should decrease with the pressures. We are, on the contrary, accustomed to see the temperatures at the stations rising, when the pressures are falling, and such is also the case in the present instance. The barometer from the 1st to the 3rd is falling and the hourly mean temperatures of the stations on the 3rd are higher than on the 1st, but the barometrical differences (b—b′) being, on the whole, very nearly the same on both days, it follows that we must find the real mean temperatures on the 3rd lower than on the 1st. To give an instance to which extent the temperature is dependent on the value of (b—b′) I will take the observation at 2 P. M. on both days. The barometrical differences were on the

1st.	3rd.
3.833	3.837

and the real mean temperatures were found to be

29°.4	28°.4.

showing a difference of one degree. To make the real mean temperature at 2 on the 3rd equal to that on the 1st, or one degree higher than we found it, the barometrical difference on the 3rd should have been 3.824, or 0.013 inches less than it was. This would have required a barometrical pressure of 25.916 inches on the hill instead of 25.903, a difference which is far too great as to have been caused by an error in the reading.

occurrence may at least be admitted. Such an admission will be sufficient to encourage further investigation into the subject.

An explanation of such a phenomenon would not only require a favourable state of the atmosphere, and observations extending over a greater number of days, but also accurate determinations of moisture and the direct observation of the greater or smaller resistance which the atmosphere offers to the passage of the sun's heating rays. It would besides have to take into account the changes in the specific gravity of the air with a rising and falling Barometer. Particular care would have to be taken to guard the thermometers against the influence of direct radiated and reflected heat from the ground. No other climate is so well adapted as that of India to bring to a satisfactory conclusion an examination into the conditions of such a phenomenon, and stations in similar relative situations as Parisnath hill and Calcutta may be found in many parts of the country.

The course of the hourly mean temperatures of the stratum of air presents another difference from the means of the stations. In India the minimum temperature is, as a general rule, observed at 6 A. M., this being the first hour of observation after, or the last hour before sunrise. In the present instance the minima in the curves of the stations, for both days, fall upon 6 A. M. It is different with the curves of real mean temperatures of the stratum of air. On the 1st, we find the minimum at 7,—on the 2nd and 3rd the hours of 6 and 7 had not been observed,—but on the 4th the temperature at 7 has not risen above that at 6. It is not surprising that the lowest temperature of the air, far removed from the ground, should occur a short time after sunrise. The air receives its temperature chiefly from the ground and some time must be required to heat the latter, and also to communicate this heat to the air in which, in the mean time the process of cooling must go on. I have (at Baroda), only six feet from the ground, in the shade of a house towards the North and protected from the rays of the rising sun, frequently observed the temperature still falling for a quarter and half an hour after sunrise, the decrease between sunrise and the moment when the temperature commenced to rise again amounting to 2 or 3 tenths of a degree Centigrade.

This phenomenon will most likely be observed only under favorable circumstances and in places where the ground remains in the shade for some time after sunrise. Mr. Radanath Sikhdar in charge of the observatory at Calcutta, where once or twice every month readings of the thermometer are taken from ten to ten minutes before and after sunrise,* has noticed the same circumstance. His kindness has enabled me to give the following table, containing the observations made on the 22nd January, 7th and 23rd February and 21st March, 1857. The state of the weather on those days was particularly favourable, there having been no clouds or rain, which, in all other months are apt to interfere with the regularity of the phenomenon. I give the readings in degrees Fahrenheit, the scale by which they have been observed.

1857.	Minutes before sunrise. 20	10	Sunrise. 0	Minutes after sunrise. 10	20	30	40	50	60
22d January,	54.0	53.9	53.8	53.7	53.6	53.6	53.6	53.7	
7th February,	63.0	62.9	62.8	62.6	62.4	62.2	62.0	62.0	62.3
23d February,	70.0	70.0	69.8	69.8	69.5	69.4	69.3	69.5	69.8
21st March,	74.8	74.6	74.7	74.7	74.6	74.6	74.8	75.2	
Means,.....	65.45	65.35	65.27	65.20	65.02	64.95	64.92	65.20	

Looking at the means, we find that the lowest temperature took place forty minutes after sunrise and the difference between the temperature at sunrise and the lowest temperature, is 0°.35 F. or about 0°.2 C.

Correction of the Barometrical readings.—The alterations to which it has been necessary to subject the curve of the real mean temperatures, in order to reduce its smaller irregular deviations, involve an examination of the barometrical readings from which these temperatures have been derived. From the formula for the calculation of the real mean temperatures, given above, it is seen that the value of the tem-

* Since January 1857.

perature solely depends on the quantity Log $\frac{b}{b'}$, all other terms of the equation being constant quantities for all hours. An error in the temperature would therefore indicate an error in one of the barometrical readings, or in both. Having corrected the temperature, we shall be enabled to find the magnitnde of the error in the barometrical reading at the one station, provided that of the other can be relied on.

The error to which barometrical observations are liable, is composed of two parts—the unavoidable error, which is attached to every reading and depends on the imperfection of the instruments and of the eye of the observer, and the incidental error, caused by unfavourable external circumstances attending the observation, as for instance shaking of the instrnment, a bad light, unsteadiness of the eye from mnscnlar exertion, &c. In converting the readings of one instrument into those of another with which it had been compared beforehand, the nnavoidable error is inclnded in the small allowance which must be made in adding the correction. In the present case this allowance amonnts to ± 0.003 inches. The incidental error cannot well be estimated. It must be more or less irregular and may be greater or smaller than the unavoidable error; generally greater.

In cases like the present, wishing to correct the errors as far as possible, we must be satisfied to assnme the readings of one of the stations as correct and alter those of the other, being gnided in onr selection by the circumstances of the case. Such a proceeding can not lead wrong so long as the corrections do not exceed the probable limits of the errors of observation. Shonld they appear to do so, this would prove that in the first instance the correction of the temperatnres must have been erroneous. So we have in these barometrical corrections a means of controlling to some extent the alterations made in the curve of real mean temperatnres. In our case, the readings of the Barometer at Calcutta, the instrument being a standard, fixed in its position and never removed from its place, necessarily had been less exposed to incidental errors than those of the mountain barometer, which was frequently changed from one place to another and could not be suspended so as to avoid oscillation.

Taking therefore the observations at Calcutta as correct, the readings on the hill had to be altered to suit the corrected temperatures. It will be seen from the following table that these alterations, reaching at the most 0.005 inches, keep within the limits of admissible errors. This is in so far satisfactory, as it confirms the adjustment of temperatures, showing that the common incidental irregularities of the barometrical readings might have produced the deviations.

VI.—Table of corrected Barometrical Readings on the Hill.

Date.	Time.	Original Reading.	Corrected Reading.	Error.
1st April.	Noon.	26.021	26.026	+ 0.005
	1	26.006	26.002	— 0.004
3rd April.	8	25.944	25.940	— 0.004
	10*	25.971	25.974	+ 0.003
	11	25 968	25.969	+ 0.001
	Noon.	25.960	25,959	— 0.001
	3	25.872	25.873	+ 0.001
	4	25.856	25.858	+ 0.002
	5	25.849	25.847	— 0.002
	7	25.860	25.856	— 0.004

Barometrical Difference.—There is another way of controlling the curve of real hourly mean temperatures. It consists in comparing the curve with the course of the hourly variation of the difference between the barometrical pressures (b—b′), obtained by deducting the pressure of the upper station from that of the lower one. If the barometrical pressures at each station, as is generally assumed, represent the Mass of the atmospheric column which presses upon the Mercury of the barometer, their difference must give the weight of the column of air between the stations, measured by a column of Mercury of an equal basis.

The weight of a fixed volume of air, being dependent on the barometrical pressure and the temperature, changes in a direct proportion as the former and, to a certain extent, inversely with the latter. The variation in the weight of such a volume of air, when

* 10 h. 10 m.

the temperature changes from t′ to t″ and the pressure from b′ to b″, is expressed by the following equation:

$$\frac{S''}{S'} = \frac{a + t'}{a + t''} \cdot \frac{b''}{b'}$$

Where S′ and S″ stand for the weight of the same volume of air at the respective temperatures t′, t″ and under the pressure b′, b″. The constant $a = 272.85$; $\frac{1}{a} = 0.003665$ being the increase in volume of a quantity of air measured at 0° C. for every degree Centigrade above zero.

This equation expresses at the same time the ratio of the variation in the specific gravity of the air.

Applying this equation to the present case, we find that the factor $\frac{b''}{b'}$, within a period of 24 hours, changes in narrower limits than the factor $\frac{a + t''}{a + t'}$, which is dependent on the hourly variation of the temperature during the day. The latter therefore will preponderate in determining the value of the equation, and we may expect to find the hourly weight of the air between the two stations following a similar course as the real hourly mean temperatures, but in an inverse ratio, the smallest barometrical difference falling upon 2 P. M., and the highest upon 7 A. M. The following table, in Col. II., gives the hourly differences as found by deducting the pressure at Parisnath from that at Calcutta. For the corrected hours the differences obtained from the original readings on the hill have been placed opposite, in Col. I.

Table VII.—Barometrical Differences.

Time.	I. Original of corrected hours.	II. Observed and corrected.	III. Calculated.	IV. Deviation.	I. Original of corrected hours.	II. Observed and corrected.	III. Calculated.	IV. Deviation.	II. Observed.	III. Calculated.	IV. Deviation.
	1st April.				3rd April.				4th April.		
6	:	3.887	3.916	0.029	:	:	:	:	3.854	3.912	0.028
7	:	3.895	3.924	0.029	:	:	:	:	3.886	3.914	0.028
8	:	3.891	3.920	0.029	3.872	3.876	3.904	0.028	3.883	3.911	0.028
9	:	3.881	3.910	0.029	:	3.876	3.904	0.028	3.879	3.907	0.028
10	:	3.874	3.905	0.031	3.876	3.873	3.901*	0.028			
11	:	3.862	3.892	0.030	3.868	3.867	3.895	0.028			
Noon.	3.859	3.854	3.884	0.030	3.856	3.857	3.886	0.030			
1	3.836	3.840	3.870	0.030	:	3.846	3.876	0.030			
2	:	3.833	3.864	0.031	:	3.837	3.867	0.029			
3	:	3.836	3.866	0.030	3.840	3.839	3.868	0.029			
4	:	3.844	3.874	0.030	3.845	3.843	3.872	0.029			
5	:	:	:	:	3.842	3.844	3.873	0.029			
6	:	:	:	:	:	3.846	3.875	0.029			
7	:	:	:	:	3.845	3.849	3.877	0.029			
8	:	:	:	:	:	3.854	3.883	0.029			
9	:	:	:	:	:	3.861	3.889	0.028			
10	:	:	:	:	:	3.863	3.891	0.028			

* 10 h. 10 m.

Examining Col. II. we find, that on the 1st and 3rd April, the barometrical differences decrease steadily from 7 A. M. till 2 P. M. and rise again after that hour.

The hour of the maximum weight on the 1st and 4th coincides with that of the minimum temperature at 7 A. M. and the hour of the minimum weight on the 1st and 3rd with the hour of the highest temperature 2 P. M. on those days. If the values of the difference, derived from the uncorrected barometrical readings on the Hill, in Col. I., are substituted for the corrected values opposite in Col. II., the general character of the series remains the same, but they would produce slight irregularities at some hours which the cor-

rections have served to eliminate. Between the hours 8 and 9 A. M. on the 3rd, only, have the corrections failed to restore the course to that regularity, which prevails on the two other days, and the barometrical pressure on the Hill at those hours appears still too high; but as any further alteration would only have been arbitrary, it was not attempted.

The general conformity of the variation in the hourly weight with the course indicated by the real mean temperatures having thus been established, it remains to be proved, that the relation between the hourly weights strictly corresponds to the course prescribed by theory, with regard also to the barometrical pressure.

The shortest way to ascertain this, would be, to compute the weight of the column of air for every hour, and to compare the values thus theoretically obtained, with the observed barometrical differences.

Neglecting for the present the influence of the watery vapour contained in the atmosphere, the weight of the column of air between the stations, measured by a column of mercury of an equal basis at 0° C. would be expressed by the following formula:

$$S = \frac{H}{p} \cdot \frac{a}{a+t} \cdot \frac{b}{B}$$

where S stands for the weight.

H gives the height in English inches (Log H = 4.6854873);

p is the specific gravity of Mercury, that of the atmospheric air, at 0° C. and under the normal pressure being taken as unity. Taking 13.59593* as the specific gravity of Mercury, and 0.001290445† as

* Regnault, in Poggendorff's Annalen Vol. LXXIV. 1849.

† The weight of 1 Litre atmospheric air in Latitude ϕ and the height a above the sea level is

$$1.\ \text{grm}\ 292753 \frac{1 - 0.0025935 \cos 2\phi}{1 + \frac{2a}{R}}.$$

From Regnault's determination, Poggendorff's Annalen Vol. XCVIII. page 178. The latitude of Calcutta is 22° 33′, and that of Parisnath hill 23° 57′ 37″. Taking the mean of both, 23° 15′ and neglecting the correction for the elevation above the sea level, which is only 18 feet at Calcutta, the weight of 1 Litre air at the latitude 23° 15′ will be 1. grm 290445; Log. = 0.1107395.

that of the air, in the latitude 23° 15′, both being compared with water, we obtain the value of $p = 10535.8$ (Log $p = 4.0226694$.) If the height of a column of air $H = 1$, then the height of a column of Mercury of the same weight and of an equal basis is $\frac{1}{p}$;

α has the same value as in the last equation (Log. $\alpha = 2.4359260$)

t stands for the real mean temperature of the air.

b stands for the mean barometrical pressure between the stations.

B is the normal barometrical pressure at 0° C. $B = 29.9218$.

If we put $\frac{H\,\alpha}{p\,B} = A$, the equation becomes

$$S = A\,\frac{1}{\alpha + t}\,b$$

and introducing the numerical values we find $A = 41.95234$ (Log. $A = 1.6227562$).

The values for t were taken from the table of real mean temperatures. The mean pressures (b) were found by taking the pressure at the lower station as the first, and the pressure at the upper station as the last term of a geometrical progression, and the height in feet as the number of terms. The sum of all terms, divided by the height in feet would approach the mean pressure sufficiently near for our purpose.* To obtain the sums, it was necessary first to find the common ratio, r, of the progression of each separate hour. In the Appendix I have given the Logarithms of the hourly values of r as also the values of $r - 1$, and the resulting mean pressures.

The final coincidence of the results of the calculation of S by means of this formula, with the observed barometrical differences, will depend on the correctness of the determination of H, t and b.

* I have, in calculating the mean barometrical pressures, neglected to reduce the height of the barometer at the upper station to the gravity at the level of Calcutta. The correction would alter the mean pressure so little (less than 0.001 inch) that it would form only an insignificant part of the error, which, as I have ascertained, must be allowed in the value obtained by the method I employed, amounting to about ± 0.005 inches. The correction would have no appreciable effect on the value of S.

I will now assume the value found for each of these quantities to be nearly correct and will consider the magnitude of the error which would be caused by smaller deviations from the truth in each.

In doing this, an error in the height cannot be considered separately as it would alter at the same time the values of t and b. A variation iu the height would change the value of the real mean temperature in the same direction, but in a greater proportion.

The influence of this error upon the value of H $\frac{a}{a+t}$, or the volume of the air, reduced to 0° C., would in the present case be very slight. The alteration in A for ± 10 feet would be ± 0.1. The value of the mean pressure cannot be obtained nearer than within about ± 0.005 inches. It would generally, the pressures remaining unaltered, for a greater height become a little smaller and for a smaller height greater and thus partly compeusate the error in the temperature, the difference only of both appearing in the final result. In the present case, the effect of both, for a difference of ± 10 feet would cause a variation in the value of S, amounting to about ± 0.002 inches or less. An error in the barometrical readings at either station would tend to produce similar irregularities in the computed hourly variations of the weight, as have been found in the observed barometrical differences.

If my assumptious regarding the correctness of the values which have been found for H., t and b are right, the foregoing considerations would lead us to expect, that the computed barometrical difference would not differ from those observed by more than a few thousandths of an inch.

This result will however be modified by the presence of moisture in the air, which I have hitherto neglected, and which would alter the specific gravity of the air and therefore the value of p.

The computed values of the barometrical differences are given in Table VII. Column III. Corresponding as they do to the weight of a columu of dry air, they are much higher than the observed weights in Column II. The deviations between the computed and observed values of S show very little variatiou, ranging between 0.028 and 0.031 inches. In every other respect the computed values show exactly the same course as those observed. We shall see how far their deviation may be attributed to the moisture in the air.

Moisture.—Observations of the moisture on the hill had been made on the 2nd for the hours 9 h. 15 m., 10 h. 15 m., 5 and 6, and on the 3rd for the hours 9, 10, 2, 3, 4, 5, 6. The observations, and the tensions of moisture, computed for the hill and for Calcutta by August's formula, are given in the following table. The column headed with t gives the reading of the dry bulb, t — t′ the difference between the dry and wet bulb. The last column contains, only for the 3rd April, the means between the tensions at Calcutta and on the hill.

Table VIII.—Tension of Moisture.

Time.	Temple.			Calcutta.			Mean Tension. Inches.
2nd April.	t	t — t′	Tension. Inches.	t	t — t′	Tension. Inches.	
9 h. 15 m. A. M.	23.3	9 6	0.238	30 1	4.3	0.856	
10 h. 15 m. „	23.7	9.3	0.264	31.8	5 3	0.869	
4 h. 55 m. P. M.	26.9	10.5	0.311	35.6	10.8	0.609	
6 „	25.5	10.4	0.262	33.3	8.9	0.655	
3rd April.							
9 A. M.	24.2	10.2	0.203	39.1	3.3	0.941	0.572
10 h. 10 m.	25.2	10.0	0.242	31.9	4.2	0.972	0.607
2 P. M.	30.3	12 9	0.283	36.1	7.8	0.913	0.598
3 „	30.1	13.7	0.230	36.3	8.0	0.909	0.569
4 „	30.0	13.2	0.255	36.0	6.6	1.020	0.637
5 „	28.1	12.9	0.209	34 7	5 2	1 065	0.637
6 „	26.7	11.9	0.219	32.3	3.8	1.045	0.632

The regular course, which the tension of vapour during the dry months follows at Calcutta, is this: the tension is at a minimum between 5 and 7 A. M. or about sunrise, and attains a maximum at 9 or 10. It comes to a second minimum between 1 and 4 P. M. and reaches a second maximum between 6 and 8 in the evening. About this maximum the tension either oscillates for some hours or it begins at once to decrease again till sunrise. Figs. 9 and 10.

A general coincidence with this course can be traced in the few observations at Calcutta, on the 3rd, which are here recorded. The figure 7 in the plate gives the curve more complete.

With the tensions obtained on the third I have computed the values of S for air mixed with vapour, at the respective hours. Adapting the formula for that purpose, aud taking 0.622 as the specific gravity of vapour, that of air of the same temperature and pressure being uuity, it becomes

$$S = A \frac{1}{a + t} \left\{ b - 0.378\, e \right\}$$

where e stauds for the mean tensiou of vapour between the two stations. The values for e were obtained by taking the arithmetical means of the tensions observed at the corresponding hours on the hill and at Calcutta. (Mean tension, Table VIII.)

An error of 0.04 or 0.05 inches in the value of e would produce a difference of about 0.003 inches in the resulting weight; but iu the opposite direction to that of the error in the moisture.

Table IX. of barometrical differences for moist air on the 3rd.

Time.	S. Observed.	S. Calculated.	Deviation or error.
9 A. M.	3.876	3.873	— 0.003
10h. 10m.	3.873	3.869	— 0.004
2	3.837	3.836	— 0.001
3	3.839	3.838	— 0.001
4	3 843	3.838	— 0.005
5	3.844	3.840	— 0.004
6	3.846	3.842	— 0.004
Average,	..	..	— 0 003

The computed values of S are now closely approaching the observed values. The small differences still remaining are easily accounted for by the probable errors in the height and in the tensions of moisture. A series of experiments which I made for comparing the indications of the wet bulb, at temperatures from 28° to 31°, and with tensions from 0.3 to 0.8 inches, with those of Regnault's Dew poiut apparatus gave this result: the tensions obtained by August's formula were always higher thau those derived from the direct observation of the Dew point. The difference was on an average 0.05 inches and varied from 0.006 to 0.08 inches. It was smallest with lower tensions and increased as they became greater. Regnault's formula gave still greater differences.

Assuming that the mean tensions in table VIII. each being the mean between a higher tension, at Calcutta, and a lower one on the hill, were on an average about 0.04 inches too high, the negative character of the error in the computed values of S, and its quantity, are at once explained.

The close correspondence, taking the moisture into account, of the computed values of S with the observed barometrical differences, allows a conclusion, that the quantities H., t and b, employed in their calculation could not have differed materially from their true values.*

It also assures us of the complete control we may, with good observations and a favorable state of the atmosphere, exert over the changes in the specific gravity of a stratum of air between two stations, appropriately situated, and their causes. The advantage of such a control, if its general applicability be once fairly established, as a means of testing and correcting meteorological observations of all kinds, is obvious.

I am well aware that conclusions, drawn from so small a number of observations, as in the present instance at my disposal, and results based upon quantities, which themselves require verification, have no claim to generality before they have been repeatedly confirmed. It is possible, if the height of the temple had been determined by better methods, than I could use, and if the determination of moisture had been more accurate than the method employed will

* As it may be of interest to know the influence which an alteration in the value of p would have upon the value of S, I give the results of table IX. as obtained if the old values of the specific gravity of mercury (13.598) and of air (0.0012991) are employed, which would make p = 10467.24.

Time.	S. Observed.	S. Calculated.	Deviation or error.
9 A. M.	3.876	3.899	0.023
10h. 10m.	3.873	3.894	0.021
2	3.837	3.861	0.024
3	3.839	3.363	0.024
4	3.843	3.863	0.020
5	3.844	3.865	0.021
6	3.846	3.867	0.021
Average, ..	..	..	0.022

admit of, that the results obtained by calculation might not have agreed quite so well, or quite in the same way, with the values observed, as they apparently did: but in all such cases, a deviation from expected results will teach us something new. My intention in discussing these observations in the manner I have done, having been less to establish a law from the conclusions arrived at, than to direct the attention of meteorologists to the advantage of corresponding observations between stations similarly situated as Parisnath hill and Calcutta, particularly in India, and to invite repetition; I shall be fully satisfied, if that object be gained.

In connexion with the latter part of the discussion, I beg permission to offer a few remarks regarding the action of the watery vapour mixed with the atmosphere.

I give in Fig. 6—8 the curves of the hourly tensions of moisture on the 2nd (6), 3rd (7) and a part of the 4th (8) of April at Calcutta, and in Fig. 13 a fragment of the same curve on the hill. Fig. 9 is the curve of the mean hourly tensions for the whole month of April, and Fig. 10 for the whole year at Calcutta; the Figs. 11 and 12 represent the curve for the month of April and the whole year of 1850 at Bombay. The Fig. 6 a — 13 a, give the hourly barometrical pressures for the same dates, and 6 b — 13 b, the curves of the so-called pressure of the dry air, that is, the curves which remain after deducting the hourly tensions of vapour (6 — 13) from the respective hourly barometric pressures (6 a — 13 a).

The tensions of Figs. 6, 7, 8, 9 and 13 were calculated from the observations, by August's formula; those of Fig. 10 were computed from the published monthly results of the Calcutta Observatory, which are obtained by the so-called Greenwich constants; the individual values are on an average about 0.018 inches lower than those obtained by August's formula, but the general course of the hourly variations remains the same. The tensions of Figs. 11 and 12 were taken from the Register of the Bombay Observatory, where Apjohn's formula is in use.*

* The readings of the barometer and tensions of moisture which served for the construction of the curves are given in the Appendix, with the exception of those of the monthly curves at Calcutta, which are published in the Society's Journal, and the curves of Bombay, which are also published.

Examining the barometrical curves 6 a — 13 a, separately, it will be seen, that the barometrical curves of the single days, 6 a, 7 a, 8 a, 13 a, show, within very small limits, the same turning points, the same general proportions, and preserve the same regularity in their gradual transition from one hour to the next, as the curves of the mean hourly pressures of the whole month (9 a, 11 a) and the whole year (10 a, 12 a). This uniform resemblance may be shown for every day in the year.

Turning now to those curves which represent the so-called pressure of the dry air (6 b — 13 b), we observe, that the regularity of the barometrical curves is at once broken, the moment we deduct the tension of moisture. The irregularity produced by this operation is, as might be expected from the nature of the hourly variations in the tensions of moisture, greater in the curve of a single day (6 b, 7 b, 8 b, 13 b,) than in that of a whole month (9 b, 11 b,) and it is still partially apparent in the curves of a whole year (10 b, 12 b.) The curves of dry pressure are not only dissimilar to the barometrical curves, but differ also amongst themselves. A correction of the possible error in the determination of the tensions of moisture, particularly for single days, would not remove the irregularity, as the error for all tensions is probably on the same side and the magnitude of its variation comparatively insignificant.

The mean hourly tensions of moisture show locally a certain periodic regularity, when the means of a larger number of days are taken. But the magnitude as well as the course of their hourly changes varies with the locality (9, 11) and with the seasons. Taking the curves of single days, they will frequently be found to be entirely dissimilar to the monthly and yearly means, and also unlike each other, and often abrupt in their transitions Figs. 6, 7, 8, 9, 10, 11, 12, 13. This is not astonishing, if we remember how little is required to effect sudden changes in the relative saturation of the watery vapour in the atmosphere. I may add that the hourly variations in the curve of tensions of single days are often much greater than the whole of the daily variation in the barometrical curve.

Returning again to the barometrical curves, we find, that they also slightly alter the magnitude of their daily variation with the locality and with the seasons, but the uniform regularity in the

course of their hourly changes remains always the same. The succession of the hourly increase and decrease is always gradual, and never suddenly interrupted, as that of the moisture, and the turning points fall invariably upon nearly the same hours.

On comparing the regular course of the curve of the hourly barometrical pressures of single days with that of the so-called pressure of the dry atmosphere and considering that the change observed in the latter is produced by deducting the tension of moisture from the former, it would appear, that the daily course of the pressure of the dry atmosphere was naturally irregular, and that the vapour was always present in the exact quantity required to restore the uniformity of the barometrical curve. In fact, it would seem as if the supply of vapour was at all times and solely governed by the greater or smaller irregularity of the curve of the so-called pressure of the dry air.

Knowing the laws which regulate the supply of watery vapour, and knowing also how many accidental circumstances may alter the curve of its tension for single days, so as to make it entirely unlike its monthly or yearly mean, and observing at the same time that the curve of the hourly barometrical pressures never alters its shape for one single day, such a conclusion would, to say the least, appear very improbable.

Assuming, on the other hand, that the course of the pressure of the dry atmosphere were regular and uniform in itself, we should, from a knowledge of the frequently altered course of the moisture, expect to find this regularity disturbed by the casual admixture of more or less watery vapour. We see, however, that such is not the case in reality, the barometrical curve being quite independent of the changes in the tensions of moisture, and never irregular.

The process of obtaining the so-called pressure of the dry atmosphere by deducting the tension of vapour near the surface of the ground from the barometrical column is based upon the supposition, that the tension of vapour near the surface would, practically, not differ much from the tension which would be produced by the weight of the column of watery vapour, diffused through the whole height of the atmosphere, if it were separated from the latter, and sustained its own pressure. This would involve another assumption,

namely, that an addition of watery vapour to the air would not affect the equilibrium, or density of the latter, solely increasing the local pressure upon the mercurial column of the barometer.

From the above considerations it would appear, that this view, if allowed to approach the truth practically in the mean of a larger number of days, is hardly admissible if applied to single cases.

I will subject it to a further test by deducing with its assistance the weight of the dry air, at different hours, between Calcutta and Parisnath hill, and comparing the values which will be thus obtained with those derived by calculation.

The results obtained for S in the foregoing discussion, taking the watery vapour into account, agreed well enough with the observed barometrical differences, to justify a belief, that the quantities employed in their calculation, although subject to a certain amount of error, would not differ essentially from their true values.

Determining with the same quantities the individual weight of each, the dry air and the watery vapour in the composition of the barometrical difference, the sum of both will always be equal to the value of S as obtained by calculation.

These weights are contained in the following Table.

Table XI.—Weights of dry air and Watery Vapour.

3rd April.	Weight of Dry Air.		Weight of Vapour.		S. Calculated.	S. Observed.	Deviation or Error.
9 A. M.	3.823	+	0.050	=	3.873	3.876	— 0.003
10*	3.816	+	0.053	=	3.869	3.873	— 0.004
2 P. M.	3 784	+	0.052	=	3.836	3.837	— 0.001
3	3 789	+	0.049	=	3.838	3.839	— 0.001
4	3.783	+	0.055	=	3.838	3.843	— 0.005
5	3.785	+	0.055	=	3.840	3.844	— 0.004
6	3.787	+	0.055	=	3.842	3.846	— 0.004

According to this table the weight of the dry air between the stations, or the specific gravity of the air on the 3rd decreased towards the time of the greatest heat and oscillated between the hours 2 and 6 P. M. round a mean value, without having shown at that time a decided inclination to rise. The weight of the watery

* 10 h. 10 m.

vapour also decreased from 10 A. M. towards the time of the greatest heat and remained stationary between 4 and 6 P. M., following on the whole the course indicated by the mean tensions of moisture in table VIII.

The weight of the dry air, if determined on the assumption upon which the so-called pressure of the dry atmosphere is founded, will show a different result. If the Mass of the dry atmosphere be represented by the height of the barometrical column after deducting the tension of vapour at Calcutta, the same must be true for the hill, and the differences between the pressures of the dry air above and below must be equal to the weight of the dry air between the stations. These differences are given in the following table. Deducting them from the observed barometrical differences, the remaining quantities would represent the weight of the watery vapour between the stations.

Table XII.—The supposed weights of dry air and vapour.

3rd April.	Supposed Weight of dry Air.		Weight of Vapour.		S. Observed.
9 A. M.	3.138	+	0.738	=	3.876
10*	3.143	+	0.730	=	3.873
2 P. M.	3.207	+	0.630	=	3.837
3	3.160	+	0.679	=	3.839
4	3.078	+	0.765	=	3.843
5	2.988	+	0.856	=	3.844
6	3.020	+	0.826	=	3.846

According to these values, leaving the vapour altogether out of the question, the weight of the dry air between the stations, or the specific gravity of the air, would have increased at an enormous rate towards the time of the greatest heat, and diminished still more rapidly towards evening, a result which would be contrary to all scientific experience.

It is evident that the assumption upon which these results have been obtained, cannot represent the true nature of the case.

In endeavouring to reconcile these apparent contradictions between theory and experience, it seemed to me that the difficulty

* 10 h. 10 m.

of accounting for the absence of any visible effect of the great and irregular variations in the tension of vapour upon the daily barometrical curve might be obviated by applying the view which Bessel has developed in his paper on barometrical measurement of heights* with regard to the action of watery vapour. According to it, the watery vapour, so long as it is not saturated for the existing temperature, would in no way differ in its physical behaviour from a gas.

To explain more distinctly in what way the application of this view would obviate the difficulties I mentioned, I will make use of the following illustration.

Suppose Fig. 5, an upright hollow Cylinder, a, b, c, closed at the bottom, to be filled with a gas g, which I will suppose to be not acted upon by gravity. This gas shall be subject to a pressure, which is represented in the figure by the moveable weight p, resting on the gas, and closely fitting the cylinder like the piston of an air pump. In a state of equilibrium between the elastic force of the gas, and the weight it has to support, the gas fills the volume 2 V and exerts an elastic pressure, equal to the weight p. If now, through a stopcock B a quantity of another gas, g′, of a different density be introduced, which, under the pressure p would occupy the volume V, the weight p will be raised from b to c, and the space filled by the two gases will now be 3 V. Each of the two gases will be distributed equally throughout the space 3 V, and both together will exert the pressure p.

By the increase of volume, to which each of the gases has been subjected, their densities must have been diminished in proportion, that of the first gas g, being now one-third, and that of the second gas, g′, two-thirds less than what it was before. The pressure or elasticity of a gas, all other conditions remaining unchanged, will vary in the same proportion as its density, and consequently the elastic pressure of the first gas g, which was equal to p, will now only be $\frac{2}{3}$ p and that of the second gas, g′, only $\frac{1}{3}$ p, the sum of both being equal to p, the weight they have to support.

If we now deduct the elastic pressure of the gas g′ from the sum of the pressures of both gases, we shall not obtain the pressure

* Astronomische Nachrichten Nov. 356, 357. Taylor's Scientific Memoirs, Vol. II. 1841.

which the first gas, g, would have shown, if the other gas had never been introduced, but a smaller one.

The space between the marks a and b, which was at first only filled with the gas g contains now two gases, the quantity of the first having been diminished and replaced by a corresponding volume of the other. To express the process in one word, it may be said, that in the original space the second gas has displaced a part of the first, the pressure remaining the same.

Returning again to the original figure, if instead of the gas g′, a quantity of another gas, g″, be introduced, which, occupying the same volume, 2 V, as the gas g, exerts an elastic pressure, p′, which is smaller than p, then both gases, the volume remaining the same, would exert the pressure $p + p'$. But the weight they have to support being smaller, they will raise it until the volume they occupy will be to the original volume, 2 V, as $p + p' : p$, when equilibrium will again have been restored, the sum of their elastic pressures not exceeding p. The individual pressure of each gas would again be diminished in proportion with the alteration of its density.

Any circumscribed space in the lower part of the atmosphere, in which the circulation of the watery vapour principally takes place may be compared to the space filled by the first gas g, in the cylinder, and the moveable weight would then represent the weight of that height of the atmosphere which is pressing upon the circumscribing surface and which is balanced by the elastic pressure of the air. The third gas g″, of the same volume and smaller elastic pressure would be the watery vapour, which during the day is continually being supplied wherever water is present on the surface of the ground, or by currents of moist air.

The weight of the watery vapour itself must increase the weight of the whole atmosphere, but the variation in this addition in weight must be comparatively small, and may be neglected in applying the illustration, the greater part of the absolute quantity of watery vapour contained in the air being permanent and not subject to changes.

So long as the supply of watery vapour is equably and continuously kept up from a large surface, a state nearly approaching equilibrium must soon be established between the stratum containing the vapour and the remaining part of the atmosphere which presses

upon it. The lower stratum will expand and the tensions or elastic pressures of the air and the vapour in it will divide themselves, according to the proportion in which they are mixed, into the pressure which they have to support, whether that pressure be produced by the weight of dry air alone or of both air and vapour.

Deducting, in the lower stratum, the elastic pressure of one of its constituents from the whole pressure, the remaining quantity will not represent the Mass or weight of the entire column of the other constituent, but solely its local tension or elastic pressure.

When the equilibrium is locally disturbed by the watery vapour being supplied in irregular quantities, or withdrawn by condensation or the up-current, the tendency to restore it between the disturbed body of air and the surrounding masses must, owing to the elasticity of the medium, immediately come into play, and thus small inequalities between the elastic pressures of neighbouring masses of air, being distributed almost instantaneously over larger bodies, will not be felt upon the barometer.

In the locality where the disturbance takes place, consequently, the diminution or increase of watery vapour will only alter the respective proportions in which the elastic forces of both constituents of the atmosphere share in supporting the whole pressure, without sensibly altering the pressure itself.

In consequence of the expansion of a volume of dry air, dependent on an admixture of watery vapour with it, the density of the mass in the space which was originally occupied will be slightly diminished, as a part of the air is displaced and replaced by an equal volume of watery vapour, which is specifically lighter than air. This diminution will create in the moist air, independently of the endeavour to put its elastic pressure into equilibrium with that of the surrounding body already alluded to, a tendency to interchange its position with that of specifically heavier masses. Such an exchange cannot be accomplished in a moment, and is probably effected very slowly, if we remember that the transition between very dry and very moist air, laterally and in a vertical direction, must be gradual. The process must be particularly retarded, where large masses are concerned, and will not interfere with the more instantaneous equalisation of the elastic pressures.

If the view here developed be correct, this will in no way oppose the assumption that the mass of watery vapour contained in the atmosphere in a vertical direction is in most cases, on an average, proportionate to the tension found near the surface of the ground.

According to the foregoing, the mode in which the watery vapour chiefly affects the barometer must be two-fold: in the first place by its tension or elasticity, and secondly by its weight. The tension is found by the Hygrometer and its action has just been considered. The weight can only be determined accurately after finding the mean tension throughout the atmosphere, or within the limits of a space for which the weight is required. Directly a palpable effect of the changes in the weight during the daily period can hardly be observed, as its variation must be a very small part of the daily barometrical variation. I will, however, not omit to notice a circumstance which may perhaps partly be traced to this cause.

In the regular daily course which the hygrometric state of the air undergoes, the quantity of moisture is, as a general rule, found smallest at sunrise, when the temperature of the day has reached its minimum, and when the vapour contained in it is nearest to its point of saturation. This minimum of moisture is caused by the condensation of a part in the shape of dew and fog. The quantity of dew deposited varies with the nature of the surface,—being greater, where the ground is covered with vegetation than where it is bare, and varying for different kinds of soil. I have seen it in the month of February under a group of trees near Poonah, equal in its effects to a slight shower of rain, coming down from the leaves. Its daily quantity will be regulated besides, as well as that of the fog by the mean degree of saturation, the mean temperature of the day (the tension of saturated vapour at the mean temperature) and the daily range of temperature. In tropical climates, not far from the sea-coast, where the mean temperatures and the state of saturation in the different months change comparatively little, the influence of the daily range would probably the most prominent.

If a merely local diminution of the water suspended in the atmosphere, confined to a small space, such as for instance is caused by a shower of rain, is not always observed to effect a perceptible change in the barometrical column, this is easily accounted for by the instantaneous restoration of the equilibrium which must take effect as

the rain is falling. Widely spread and continuous falls of rain are generally accompanied with a falling or rising of the barometer, depending on other primary causes, which would screen from observation the similar or contrary effect of the rainfall. But a very slight diminution of pressure by condensation extending simultaneously over many degrees of longitude, and following the meridian as far as the sun rises and sets once every 24 hours, is much more likely to be felt, as it could not possibly be compensated for in a short space of time. Its effect, if not great, must be constant, and will be found in a smaller mean pressure during the night, than during the day.

The tropical regions, where the time of sunrise, about 6 in the morning, varies throughout the year at furthest about an hour and a half would be best adapted to show such a difference, if it is great enough to cause a visible depression of the barometrical column. I have before me the observations made in 1849 and 1850 at the Colaba Observatory in Bombay and those made at Calcutta Observatory in 1856. At Bombay the mean barometric pressure in the curve of the hourly means of every month will fall very nearly upon 6 A. M. and at Calcutta between 5 and 6 A. M. Including for the mean of the day the readings from 6 A. M. to 5 P. M. and for that of the night from 6 P. M. to 5 A. M. the pressure of the day always shows a slight excess over that of the night, as may be seen from the following table.

Table XIII.—*Excess of the barometric pressure during the day over that during the night. In Inches.*

Bombay.	Jan.	Feb.	March.	April.	May.	June.
1849	0.011	0.018	0.022	0.015	0.016	0.009
1850	0.012	0.016	0.019	0.019	0.021	0.011
Mean.	0.011	0.017	0.020	0.017	0.018	0.010
Calcutta.						
1856	0.021	0.029	0.029	0.029	0.017	0.005

Bombay.	July.	August.	Sept.	Oct.	Nov.	Dec.	Year.
1849	0 007	0.008	0.014	0.007	0.009	0.011	0.012
1850	0.008	0.013	0.009	0.009	0.012	0.014	0.013
Mean.	0.007	0.010	0.012	0.008	0.010	0.012	0.012
Calcutta.							
1856	0.003	0.006	0.015	0.015	0.009	0.017	0 015

This excess cannot be ascribed to an excess of the tension of moisture in the same direction. The mean tension of moisture of the night is, during the cold months equal to or slightly greater than that of the day.

In table XIV I have given the mean daily ranges of temperature for the same years and months.

Table XIV.—*Daily range of temperature in ° C.*

Bombay.	Jan.	Feb.	March.	April.	May.	June.
1849	7.4	6.7	6 5	6.1	5.2	2.9
1850	7.4	9.1	6.5	5.7	5.3	4.1
Mean.	7.4	7.9	6.5	5.9	5.2	3.5
Calcutta. 1856	9.3	9.8	7.8	7 5	6.0	3.7

Bombay.	July.	August.	Sept.	Oct.	Nov.	Dec.	Year.
1849	2.7	2.8	2.6	5.8	7.3	7.9	5.3
1850	2.8	3.5	4.0	5.8	7.8	7.3	5.6
Mean.	2.7	3.1	3.3	5.8	7.5	7.6	5.4
Calcutta. 1856	3.3	3.0	3.8	4.1	7.0	9.0	6.2

If their variation from month to month is not always proportionate to the variation in the excess of pressure, they show at least, that in those months for which the excess of the pressure of the day is smallest, June, July and August, during the rains, the range of temperature is also at a minimum, and increases, as the former, in the cold and hot seasons.

Supposing that the excess of barometrical pressure during the day be owing to the amount of daily precipitation by condensation, the average daily quantity of the latter would in round numbers correspond to about the following quantities of water:

Bombay 1849, 0.160 Inches.
1850, 0.180 „
Calcutta 1856, 0.200 „

which appears excessive, even for tropical climates; Bombay being situated on an Island, and Calcutta not far from the Sea, in a country largely intersected with canals and rivers, it is not impossible that the excess of the barometric pressure during the day time may partly be attributed to the difference between the quantities of evaporation during the day and during the night. Observations of the hygrometer at the sea level alone would not decide the question, as they are only of local importance. Here also simultaneous observations at some elevation above the sea level would be of great use in determining the hourly mean quantities of water contained in the atmosphere in a vertical direction.

It would be premature, at present to attempt a full explanation of the phenomenon which may, besides, depend on other causes, and is most likely connected with the regular daily variation of the height of the barometrical column. Further observations in different parts of the country would be required. A direct test of the share which the amount of daily precipitation by condensation and the quantity of evaporation have in producing the excess of barometrical pressure during the day would be found in accurate estimates of the average amount of dew and fog for every day in the year, and in determinations of the quantities of evaporation during the day and during the night.

APPENDIX.

Hours.	Barometrical Readings at Calcutta in English Inches, corrected for temperature.					Tensions of Moisture at Calcutta in English Inches.				Observed and substituted Barometrical readings on the Hill, corrected for temperature in Eng. Inches.				Interpolation of unobserved hours on the Hill.
	1st April.	2nd April.	3rd April.	4th April.	Year 1856.	2nd April.	3rd April.	4th April.	Year 1856.	1st April.	2nd April.	3rd April.	4th April.	
M.	29.825	29.793	29.756	29.755	29.791	0.921	0.962	0.982	0.799	..	25.925*	25.904*	25.886*	
1	822	790	752	751	780	868	943	987	794	..	915*	896*	880*	The readings for the hours at which no observations had been taken on the hill were derived by interpolating the barometric differences (b — b′) for those hours and deducting the values thus obtained from the barometrical readings observed at Calcutta.
2	818	779	737	738	770	862	920	984	790	..	903*	876*	865*	
3	814	775	725	732	761	843	898	982	785	..	895*	861*	856*	
4	814	769	729	740	764	811	844	977	781	..	884*	861*	861*	
5	830	776	749	752	768	781	849	983	778	..	886*	879*	871*	
6	850	801	771	778	788	750	852	968	778	25.963	909*	896*	894	
7	875	822	785	795	809	780	914	989	786	980	926*	907*	909	
8	900	855	816	811	821	810	936	995	794	26.009	963*	944	928	
9	913	880	837	831	843	841	941	979	799	032	995	961	952	
10	918	879	849	..	844	840	970	..	800	044	26.004	972	..	
11	902	870	836	..	830	643	983	..	797	040	002*	968	..	
N	880	846	816	..	807	570	1.001	..	795	021	25.996*	960	..	
1	842	816	781	..	779	555	0.981	..	791	006	976*	935	..	
2	806	774	740	..	754	579	913	..	790	25.973	952*	903	..	
3	787	744	712	..	736	584	909	..	785	951	919*	872	..	All readings marked with a star have been interpolated in this manner, vide page 8.
4	772	728	701	..	726	612	1.020	..	784	928	900*	856	..	
5	762	715	691	..	727	609	1.063	..	792	918*	884	849	..	
6	763	716	698	..	729	655	1.037	..	806	919*	885	852	..	
7	779	724	705	..	755	659	1.045	..	806	935*	891*	860	..	
8	796	746	726	..	777	643	0.984	..	802	950*	909*	872	..	
9	813	778	754	..	794	779	989	..	802	959*	936*	893	..	
10	823	781	770	..	802	974	995	..	795	965*	938*	907	..	
11	815	775	771	..	800	985	982	..	797	952*	927*	904*	..	

APPENDIX.

Values employed in the Calculation of the mean Barometric Pressures.

1st April.				3rd April.			
Time.	Log r.	r — 1	Mean Pressure. Inches.	Time.	Log r.	r — 1	Mean Pressure. Inches.
6 A. M.	— 0.000015000	— 0.00003455	27.859	6	....	....	....
7	15020	3459	27.884	7	....	....	....
8	14990	3452	27.912	8	— 0.000014975	— 0.00003449	27.829
9	14945	3442	27.921	9	14965	3447	27.845
10	14910	3434	27.936	10	14950	3443	27.856
11	14870	3425	27.922	11	14930	3439	27.845
Noon.	14850	3421	27.897	Noon.	14900	3432	27.830
1	14815	3413	27.861	1	14870	3425	27.807
2	14805	3410	27.835	2	14856	3422	27.767
3	14825	3415	27.816	3	14880	3427	27.740
4	14870	3425	27.793	4	14900	3432	27.729
				5	14910	3434	27.720
4th April.				6	14915	3435	27.726
6 A. M.	— 0.000015030	— 0.00003461	27.790	7	14925	3437	27.732
7	15030	3461	27.804	8	14930	3439	27.751
8	15010	3457	27.815	9	14950	3443	27.770
9	14980	3450	27.844	10	14950	3443	27.784

Buddhism and Odinism,—their similitude; illustrated by Extracts from Professor Holmboe's Memoir on the "Traces de Buddhisme en Norvége."—By Bábu RÁJENDRALÁL MITRA.

The obscurity in which the early history of India is enveloped, has led the antiquary to hope that some light may be cast upon it by the acquisition of monumental evidence. In that hope he has laboured with assiduous care on inscriptions, coins, ancient buildings and sepulchral mounds. He has met with relics which keep alive his hope, and induce further investigation, and he has clung to the expectation of one day finding enough to fill up the gap which has been left in the annals of the country by the poverty of its historic muse. Experience has taught him not to anticipate great results from any particular research, for the unremitting labour of days and months often brings him nothing better than a rude mouldering urn, or a simple heap of ashes; but he knows that little as such results are, they still add that little to our scanty stock of knowledge, and will in time accumulate, and be the means of elucidating much in connexion with the manners and customs of the ancient inhabitants of this land and their relation to other nations of antiquity.

The gleanings which have thus been brought together during the last fifty years in connexion with the history of Buddhism, are already considerable. The era of Sákya Siñha has been established on the most authentic testimony, and his biography is now nearly as well known as of any other individual who lived two thousand five hundred years ago. Viháras, chaityas and pillars point out the city of his birth, the places where he sojourned, the spot where he died, and the monuments that were erected on his mortal remains. The history of the religion he taught is being daily more and more developed, and the darkness which hung over the course that religion took in its spread over the different regions of Asia is well nigh dispelled.

Sir William Jones was the first who was struck by the similitude of the words Buddha and Odin, and others noticed the coincidence of their use in designating the fourth day of the week; but fifty years ago there was nothing but vague suspicion that in its onward

course, Buddhism had travelled across the bounds of Asia and gone on beyond the furthest limits of the European continent to the freezing isle of Iceland, or that Odinism was nothing more than a modification of the religion taught by the renowned prophet of Magadha. The fact, however, has now emerged from the region of crude conjectural speculation, and though not yet established as a positive antiquarian discovery, has an array of evidence in its favour, which will direct the course of subsequent inquiry and lead to a definite consequence. Professor Westergaard and others have shewn that the old Icelandic language bears a strong resemblance and, most probably, owes its origin to the Sanskrita, and the work, of which we propose to make this paper a brief summary, points out the relics which still exist both in Iceland and Scandinavia of the former predominance in those places of a religion akin to Buddhism.

It is much to be regretted that our enquiry into this subject has to be conducted under serious disadvantages. History in Scandinavia, until after the eleventh century, was as sterile as in India, and the reader of Pagan literature knows even less of the doctrines and usages of the Paganism which existed among the Northmen, than does the Purânic, with reference to the Hinduism of the middle ages. Of the doctrines and institutions of the religion of Odin we havo little that can be used for historical purposes. They are vague and mystified, and evidently never formed the subject of the records (Eddas) which have been handed down to us. Nor are we more fortunate in the material remains of Odinism. The North is even more poor than the East in relics of temples, statues, emblems, images and symbols. The little, however, that are still available both of legends and antiquities, bear so strong a resemblance to Buddhist relics in India, that it would be bold indeed to declaro that their similitude is the result of an accidental coincidence.

Buddhism is characterised as eminently spiritual and free from idolatry, so was the religion of the Germanic race from whom Odinism was taken into Norway. Tacitus says* that the Germans held that God is the Ruler over all; every other thing is subject to and obedient to him, ("regnator omnium Deus, cetera subjecta

* Chapter 35.

atque parentia,") ; and again in another place ;* "They do not think that they can confine God within walls, nor liken him to any form of the human face, as the greatness of the celestial bodies." Herodotus says, "the Getes (ancient Norwegians) were theists and held the tenets of the soul's immortality ;"† and the Buddhists hold that these doctrines are intimately connected with their religion. The esoterics of Buddhism inculcate a trinity of Gods as supreme Arbitors of the universe; and Odinism doth the same. The Buddhists have their Buddha, Dharma and Sangha, and their counterparts appear among the Scandinavians as Odin, Thor and Frigga. Adam of Bremen, who lived about the middle of the 11th century, in describing the principal temple of Odin, says, "This nation has a most noble temple which is called Upsala, situated not far from Sictona or Birka. In this temple are statues of three gods entirely made of gold. The people worship them. Of them Thor the most powerful, occupies the floor in the centre, Woden and Fricco have places on the sides." This position of the Odinic Trinity is unmistakeably the same as that which the Buddhist trinity occupy to this day on the covers of Tibetan Manuscripts or on the Sanchi gateway. Nor are they different in their attributes. According to Grimm and other German writers, Odin, Woden and Goden were names of the Supreme divine power among the Germanic race, and Thor and Frygga were impersonations of Divine attributes. With the Buddhists, Buddha is Primitive Intelligence, and Dharma and Sangha its attributes.

Very little is known of the literature of Odinism, and of that little we have but an imperfect knowledge. From the Edda of Sæmund or that portion of it which is still extant, it would seem that the religious books of Odinism were divisible into three parts; the first or "Voluspa" referred to the creation and destruction of the earth, the doings of the gods and the futurity of the soul. The

* Chapter 9.

"Ceterum nec cohibere parietibus Deos, neque in ullam humani oris speciem assimilare ex magnitudine cœlestium arbitrantur."

† Tod's Rajasthan I. 63.

‡ "Nobilissimum illa gens templum habet quod Upsala dicitur, non longe positum a Sictona civitate vel Birka. In hoc templo, quod totum ex auro paratum est, statuas trium deorum veneratur populus, ita ut potentissimus eorum Thor in medio solum habeat triclinium, hinc et inde locum possident Woden et Fricco."

second or "Havamal" included the moral precepts; and the third was devoted to the magic powers of Odin. With the Buddhists, the division of their books is equally threefold: they too have their Sutra, Vinaya and Dharma, or fundamental principles, morals and metaphysics; and if we make a sufficient allowance for the altered physical condition and social states of the two races, the difference will be but slight.

Laing, in his translation of the Heimiskringla, after a careful examination of geneological data, deduces the date of Odin to be about the end of the third century before Christ. That would be nearly three centuries after the death of Buddha. But if we bear in mind that the Buddhist colonists to the West must have progressed but slowly, and many of them started from India even in the middle of the third century before Christ, in the reign of Asoka, and that in their translation from their Indian or Scythic homes to the banks of the Baltic, their religion suffered considerably in its purity, we will be at no loss to find the cause for the anachronism in question. To the same cause may be attributed the confusion that may be noticed in the name of Buddha. Gautama is his name elect, and this name is curiously enough reproduced in Norway as that of his son. This may be an accident. But the fact of the name being well known in two such distant places, is of itself a matter worthy of notice, and offers strong temptation to the enquiry, is Tuisto a Norwegian reproduction of the Buddhist Tusita?

In the Buddhist mythology, the greatest opponent to goodness is an immortal named Mára. He plays the same part as an adviser of evil that Satan does according to the Christian theologians. For years he tried to mislead S'ákya Siñha from his resolve to attain Buddhahood, and invariably stood in the way of all who attempted to excel in knowledge or religion. In his career of mischief he has travelled to Scandinavia, and without even much altering his name "still rides the modern Saxon in his sleep (nightmare) as he did the Ynglinge king Vanlaud."* He commanded a prominent position in the Odinic mythology, and was known exactly by the same appellation (Mara) and for the same disposition which has given him an infamous notoriety among the Buddhists.

* Laing's Sea Kings of Norway I. 92.

Col. Tod has noticed a number of curious analogies between the customs, habits, manners and belief of the Rajputs and the ancestors of the Northern Scythians; and these go a great way to shew that they could not have existed, unless we admit a community of origin. The worship of the sword, the reverence for the horse, the sacrifice of that animal as a religious obligation, were alike common both in India and Scandinavia. In Iceland, where the horse is not indigenous, there existed the same reverence for the sacrifice of that animal as it did among the Asiatic Scythians, and the early Christian fathers had to issue strict injunctions to restrain the people from indulging in that unchristian ritual.

The Indo-Scythians were an equestrian race, and unlike most other nations, used the horse both for the saddle and in the war-chariot. The charioteers were always the flower of their armies, and the heroes of the Mahábhárat and the Rámáyaṇa and even of the Vedas always appear in their chariots. Such was also the case with the Getes; they too centred their chief strength in the chariot. These analogies are, no doubt much more ancient than Buddhism, but the Hindus and the Scythians, by becoming Buddhists changed their code of theological belief, not their customs and their knowledge, and therefore they may be fairly taken, *ad valorem*, as proofs of a community of origin of the different races among whom they are found.

"In the last rites for the dead," says Tod, "comparison will yield proofs of original similarity. The funeral ceremonies of Scandinavia have distinguished the national eras; and the 'age of fire' and the 'age of hills,'* designated the periods when the warrior was committed to mother-earth or consumed on the pyre. Odin (Boodha) introduced the latter custom and the raising of tumuli over the ashes when the body was burned; as also the practice of the wife burning with her deceased lord. These manners were carried from Sacadwipa or Saca Scythia 'where the Gete,' says Herodotus 'was consumed on the pyre or burned alive with her lord.' "† It is not necessary to enquire whence the Buddhists obtained their practice of burning the dead and raising tumuli on their ashes; suffice it to say, that they have it from an early age, long before it was introduced

* Mallet's Northern Antiquities, chap. XII.

† Rajasthan I. p. 73.

into Scandinavia, and therefore it must follow that either the Buddhists gave the practice directly to the people of the North, or both must have received it from one common source, the platean of central Asia—that officina gentium whence in the darkness of a time far beyond the limits of history, peoples and races have come forth to take possession of the earth.

That the former is the case appears probable from the fact of the practice in question having been carried to the North along with the religion of the Buddhists.

Monumental remains of the Odinists, whether in Scandinavia or elsewhere, may be described as consisting principally of megaliths and mounds. The former include a variety of structures from a single erect block of stone implanted on the road-side to the most complicated and cyclopean structures, such as the Stonehenge. They are found universally distributed from India to Scandinavia, and mark the progress of the Buddhists in their migrations to the North.

The monoliths of India such as the Sati stones and lats are reproduced in Western Europe in the "standing stones," so abundant in the Channel Islands, and so peculiar to the Druidical priests. The ortholiths and parallelliths or single and double rows of standing-stones, are equally common in both places, and alike devoted to ceremonial purposes. The next are the cycloliths or circles of erect distinct stones. They sometimes enclosed open spaces, where most probably the Druids performed their ceremonials, and sometimes surrounded cromlechs or temples. In Southern India, these are still abundant, and their full development gave rise to the colonnaded enclosures which surround the topes of central India. In the large tope of Sanchi, they are rough-hewn blocks surmounted by top stones.

Dolmens, cistvaens, cromlechs and peristaliths are not without their counterparts in India—and they were evidently devoted to the same purpose. Dr. Wise, late Secretary to the General Committee of Public Instruction, in an excellent paper on the subject published in the Transactions of the Royal Society of Edinburgh,* has collected a large number of instances in which "the general identity, in

* Vol. XXI. pt. II. p. 255.

idea and design," of the Celtic structures of Europe and the Buddhist relics of India, are most curiously illustrated, and from their study, the learned author was led to the inference "that races of Asiatics proceeded westward at different ages and established themselves along the shores of the Baltic and the Mediterranean seas, and part of the Atlantic ocean; along which they have left characteristic monuments which resemble those of their original country."*

The next source of evidence of the identity of the Buddhists and the Odinists are their tumuli or mounds, which, in their most primitive form, were cairns or burrows—small heaps of earth marking the spots where were deposited the dead or their ashes; and in their full development appeared as the Topes of India and the haugs or tumuli of North Western Europe. In idea and design, they bear even a greater similitude to each other, than do the megaliths. They are generally, though not invariably, sepulchral, and are always intended to record the memory or the acts of saints, or men distinguished for their superior knowledge of religion.

Professor Holmboe's object in the memoir under notice is to prove this similitude. With that view he has examined the topes with reference to their size, their design, their grandeur, their symbolism, their interior arrangements, and their accessories, and his work attests the zeal, industry and success with which he has achieved his purpose.

The first section of the work is devoted to the examination of the Topes as the memorials of saints or their actions. He says "according to the legends of the Buddhists, they had, several centuries before the commencement of our era, adopted the custom of raising large monuments for preserving the relics of Buddha and of his principal disciples; and sometimes for perpetuating the memory of some of his actions on the spots where they had happened.

"These edifices are generally of colossal proportions, and are constructed of stones or bricks on a basement which is sometimes formed of a regular quadrangular wall; and at other times of blocks of rough stones thrown together without any order. These are called in Sanskrit *stupa*, which strictly signifies "a heap," "a mound,"

* Vide passim the Madras Journal of Literature and Science, Vols. XIII. and XIV. pp. 47 and 77 et seq. respectively, and Cunningham's Bhilsa Topes.

or "a tumulus." This word has been altered and abridged, so that the people of Hindustan and Afghanistan now call these monuments *topes:* in Afghanistan they are also called *burj* or "towers." In Ceylon they are called *tupa;* but more frequently *dagoba*, a word altered from the Sanskrit *dhatugopa*, that is the receptacle of precious relics. In Tibet they bear the name of *chostin* or *chhodtin.*

"The following legend contains a description of the Stupa and may be taken as its beau idéal.

'At that time, in the presence of Bhagavat, (Buddha) in the middle of the assembly which was facing him, from the South, there arose a stupa of seven precious substances;* it was five hundred yojanas in height, and of a proportionate circumference. It was raised high in the air, and seemed as if suspended from the skies; it was handsome and pleasing to the sight, ornamented with five thousand balconies, and strewed over with flowers, embellished with many thousands of doors, with thousands of standards and flags, and surrounded with thousands of garlands made of precious stones; having a belt made of cotton cloths and little bells, and the whole was redolent to a great distance with the perfume of the sandal and of the leaves of the tamala. The line of umbrellas with which the edifice was surmounted reached the habitations of the gods.'†

"To this legend, which describes the idéal, we will add what Mr. Cunningham says of the real tope.

"The tope" says he, "is a solid hemispherical building, varying in grandeur from the great chaitya of Sanchi, which has a diameter of 106 feet, to the smallest at Bhojpur, the diameter of which is only six feet. The most ancient topes were simple hemispheres, as the great chaitya of Sanchi, which dates probably six centuries before the era of Jesus Christ. This was continued to the period of the Bhilsa topes which date from the end of the third century of our era. In these, the hemisphere is raised some feet (from the ground) on a plinth, by the addition of a cylindrical portion. The topes of the third class are found in Afghanistan, and are not older than the commencement of the Christian era. In them, the hemis-

* i. e. of gold, silver, lapis lazuli, emerald, rock crystal, red pearls (coral ?) and diamonds.

† Lotus de la bonne loi, p. 145.

phere is considerably raised on a plinth. The last class, of which the Sarnath tope near Benares is a magnificent specimen, has a hemisphere raised to a height as great as the diameter of the tope."

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"In the topes dedicated to the celestial Buddha nothing was deposited; but the divine spirit, which is light, was supposed to dwell in the interior, and this was proclaimed outside by a pair of eyes, placed opposite to each of the four sides, either at the base or the summit of the building. Thus in the great chaitya in the neighbourhood of Kathmandu in Nepal, which is dedicated to Sambhu or Svayambhunátha, the eyes are placed on the sides near the crown of the edifice; such is also the case in numerous chodtens (m-chhod r-ten) of Tibet, which are dedicated to the celestial Buddha, and distinguished from the Dung-tens (g-Dungr-Ten) which are erected to the honour of mortal Buddhas. The first name signifies an offering to the divinity, the last a receptacle for bones (g-Dung), that is to say a building containing the bones or relics of some one of the mortal Buddhas. In that case the eyes occupy a place near the base.

"These monuments were not used exclusively for the preservation of the remains and the memory of saints, but were sometimes used for those of kings, as M. Burnouf inform us. 'According to the traditions of the Buddhists of the South,' says he, 'the relics of Buddhas were not the only objects which were entitled to preservation in these large edifices (the stupas). I find on the subject a positive injunction in *Tupa vamsa pali:* 'a venerable tathágata, who is perfectly and completely a Buddha, has a right to a stupa; a Pratchtcheka Buddha has a right to a stupa; an auditor of a tathágata has a right to a stupa; a chakkavatti Rájá has a right to a stupa.'

"As the legends of India attribute to Buddha, the origin of the stupas or topes, so does traditions of Norway attribute the origin of their haugs (or large artificial mounds) to Odin. The author of the History of the kings of Norway, Snorro Sturlason thus expresses himself on this subject:

"Odin established the same law in his land that had been in force in Asaland. Thus he established by law that all dead men should be burned, and their property laid with them upon the pile,

and the ashes be cast into the sea or buried in the earth. Thus, said he, every one will come to Valhalla with the riches he had with him upon the pile; and he would also enjoy whatever he himself had buried in the earth. For men of consequence a mound should be raised to their memory, and for all other warriors who had been distinguished for manhood, a standing stone; which custom remained long after Odin's time.'*

"Thus we have not only express statement that remains of the brave should be disposed in haugs, but history informs us that such was most frequently the case. Again, as the topes were the objects of veneration and adoration, so were the haugs in Scandinavia. There may be found traces of this respect even in later days in Norway, for there was a custom for a long time not to allow any body to fell trees or disturb the herbage in the neighbourhood of these edifices.

"The author of the work entitled the *Lalita Vistara*,† biographer of Gautama Buddha, says, that on his death, men of eight different countries disputed for his corpse, and the quarrel was not appeased until the body was divided among the combatants, of whom each raised a stupa on the portion he had got.

"Snorro relates an analogous occurrence in the History of Halfdan Swarte (or the black) king of a part of Norway. Here are his words:

"The people thought so much of him, that when his death was known, and his body was floated to Ringerige to bury it there, the people of most consequence from Ranmarige, Westfold, and Hedemark, came to meet it. All desired to take the body with them to bury it in their own district, and they thought that those who got it would have good crops to expect. At last it was agreed to divide the body into four parts. The head was laid in a mound at Stein in Ringerige, and each of the others took his part home and laid it in a mound; and these have since been called 'Halfdan's mounds.'"‡

The Saga tradition, it will be perceived runs on all fours with the

* Apud Laing, vol. I. p. 223.

† The Lalita Vistara does not advert to this circumstance. M. Csoma de Körös noticed it in the Dulva. See his Essay on the Life of Sákya Siñha; Asiatic Researches, vol. XX. p. 315 et seq.

‡ Apud Laing, vol. I. p. 269.

description of the disposal of the remains of Buddha, as given in the Tibetan books, and although relating to circumstances which occurred at a very distant place, still affords an instance of a coincidence which cannot be altogether valueless in examining the relation of the two systems of religion.

"In the manner of treating the remains of the dead, the analogy is borne not only in burying the body and erecting topes thereon, but we find that in Scandinavia, the ashes of men of little importance were deposited in urns and buried under earth or thrown into the water, just as the Buddhists of Ceylon put the ashes of their dead into urns and deposite them under the earth, or as the Buddhists of Nepal, who throw the ashes of their dead into water" (p. 8.)

The second section of the work is devoted to shew the identity of the form of the haugs of Norway with the topes of India; and then follow in the next section a few hypotheses as to the symbolism of the tope; the most probable of which appear to be that they represent a bubble floating on the sea as emblematic of the vanity of the human body.

In the fourth section the author conveys an idea of the immense masses of materials that are brought together to give to these monuments an imposing appearance, by describing the size of some of the largest topes and haugs.

He says, "the Valdershaug at Valderöe, an island near the coast of Söndmör, a district in the diocese of Bergen, is nearly four hundred feet in circumference, and from 14 to 16 feet in perpendicular height. It appears to have been twice as high before.

"The *Aushaug* in the parish of Ulfsteen, diocese of Bergen, has a circumference of 450 feet, and a height of 32 feet. A haug at Vigeröe in the same diocese, has a circumference of 330 feet and a height of 24 feet. In the parish of Urland of the same diocese, there are several haugs, some of which are more than 400 feet in circumference. In the parish of Glopen of the same diocese, there is a haug having a circumference of more than 530 feet and a perpendicular height of 24 feet. In the parish of Yttre Holmedal of the same diocese, there are two haugs, one of which is 340 feet in circumference and 32 feet in height, and the other 400 feet in circumference and 16 to 18 feet in height.

"It should be remarked that the dimensions above given, have not been measured by instruments, but that the circumference was ascertained by a man walking round the ruins, and the height by a comparison with the height of man.

"We shall now measure a few of the most considerable topes in Asia. The *Manikyala tope*, between Attock and Lahore, is 310 to 320 feet in circumference, and, even to our days, has a height of 80 feet; it was considerably higher before.

"The *Amarávatí tope*, near the river Krishṇá, in the Guntoor Sircar, has a circumference of 500 feet, and a height, at present, of 16 feet only.

"The *Bhilsa tope*, in the neighbourhood of Sanchi, S. W. of Bundlekund, is 554 feet in circumference, and 120 feet in height. It was higher before.

"The *Abhayagiri Dagoba*, in Ceylon, at present has a height of 220 feet; but tradition says that at one time it had a height of 408 feet.

"The *Jaitavana Dagoba*, also in Ceylon, had, it is said, a height of 360 feet, and still contains a number of bricks which would, according to the calculation of Major Forbes, suffice for a wall six feet high, two feet broad, and 97 English miles in length (nearly 30 leagues French.)

"The topes of Afghanistan are rarely more than 150 feet in circumference, and their height is ordinarily 30 to 40 feet.

"The *Mahástupa*, also called *Sonnávali*, which Rájá Duchtagamani had erected near the ancient capital of Ceylon, is placed on a square terrace 180 feet on each side, and paved all over with flags of granite. The stupa itself is 120 feet in diameter and 189 feet in height."

Compared with Indian topes the haugs noticed by M. Holmboe appear to be wanting much in height. But they are not always quite so low. Professor Verelius, in his notes on the Harvrar Saga, adverts to 669 tumuli, of which three, near Gamle Upsala, are said to be three hundred and fifty paces in circumference, and the ascent to them on any side takes about seventy-five steps, which would give them a perpendicular height of more than ninety feet.

With reference to the construction of these monuments, M. Holmboe observes that while the Indian edifices are all built with

cement, those of Norway and Finmark shew no signs of any cement having been used in their construction.

In the interior of the tope as well as of the haug there is a quadrangular chamber formed of flags of stone, and placed generally on a level with the ground surrounding the monument, sometimes on a level with the upper surface of the basement, and sometimes higher up, but never below the level of the surrounding land.

As appendages to the topes and the haugs may be enumerated flags on the summit, pilasters on the sides, pillars around, pavements and ditches surrounding the tumuli, tanks and tombs in their vicinity, and cells of the officiating priests.

Flags were common to the monuments both of India and Norway; but of the other accessories, Norwegian monuments seem to have had less than those of India. Tanks and wells are invariably found in the neighbourhood of topes, because supplies of water were absolute necessities for ceremonial purposes among the Indian Buddhists; but in a country like Norway, where ablutions could not be generally enforced, they must necessarily be few. They are, however, not altogether wanting. At Vigeröe, near the coast of Söndmör in the diocese of Bergen, there is a large haug, having in its neighbourhood a rectangular excavation, 54 feet long, 40 feet broad, and 6 feet deep, the sides being regular and sloping. It is singular in appearance and attracts the attention of all who visit the locality. To account for its origin, it has been said that it was excavated to afford the necessary material for the erection of the haug; while others suppose it to be the foundation of a house; but both these hypotheses seem to be inconsistent with its regular shape and sloping sides, and we must therefore take it to be the remains of a tank. Similar excavations exist in the neighbourhood of haugs in the districts of Indre-Holmedal, Yttre-Holmedal, Sielöe and Tysnaes.* M. Ström† supposes that there existed at one time a subterranean

* "It is curious, that in the United States of America may be found artificial mounds, consisting of many layers of different materials and formed in the shape of cupolas, often having a tank in its vicinity (Transact. American Ethnological Society, Vol. III. p. 157). These mounds suggest the idea of a population proceeding from the Norwegians, who discovered America in the year 1000 of our era." Holmboe, p. 23.

† *Söndmörs Beskrivelse II. p.* 41.

passage from the excavation at Gamle Upsala to the haug in its neighbourhood: traces of such passages have been found under mounds and barrows in the north of England; and Indian antiquarians have suspected their existence under the topes of Ceylon and Central India. Mr. Masson notices them in the neighbourhood of Afghan topes.

Pilasters are not necessary adjuncts to topes: they occur on the cylindrical shafts of the topes of the second class, such as those of Afghanistan,and may be compared with a peculiar construction on the Kougshaug at Angvaldsnæs in the island of Karmöe. M. Holmboe describes it thus: "The sides of the haug are ornamented with a series of small cells or chambers open in the front, of which the intermediate spaces, at some distance, present the appearance of pilasters."*

Collonaded verandas round the central hemisphere are unknown in Norway. In India, they are noticable only in the most finished topes, such as those of Anurádhápur of Ceylon, and of Bhilsa and Afghanistan. Ranges of pillars of brick or stone, and wooden palisades are not uncommon around topes. They enclosed spaces which used, most probably, to be occupied by the congregation on days of public worship. In some topes two and even three ranges of palisades have been found.† They do not seem to have been very frequent around haugs, but around the bontrœhaug‡ (mound of the bou tree) there may be seen a range of stone shafts set up vertically which bear the closest analogy to the palisades in question. Around the great temple of Gamle Upsala, a wooden palisade is supposed to have existed, and we read in Scaldic poetry of a golden ring, or chain, or serpent, surrounding the temple of Odin which, it would be no great stretch of imagination, to reckon as the counter-

* Holmboe, p. 18.

† A fence similar to this has been noticed by Dr. Wise around a Hindu temple at Calna, belonging to the Rájá of Burdwan. In a neighbouring temple I was struck by the appearance of a stone figure which was represented to me as that of Vishṇu, but which bore the closest similitude to the Buddhist figures excavated by the late Major M. Kittoe from the ruins of Buddha Gaya.

‡ *Urda* 11, p. 325. I have no means of ascertaining the Norwegian meaning of the word *bou*, but its use in connexion with a haug suggests the idea of its similitude with the Buddhist "bo" being more than accidental.

part of the Indian palisades. In Burmah the fences of the *kiungs* are made of the tails of dragons and monsters whose heads ornament the sides of the gateway.

Small tombs in the neighbourhood of topes and haugs owe their origin to an idea of sanctity attached to these monuments, and the desire, so common in mankind, to place the remains of their relatives in or about places reputed to be holy. In Afghanistan these tombs differ from the topes in not having the cylindrical shaft which joins the hemisphere of the tope with the basement, and their contents being purely sepulchral in their character, consisting chiefly of bones, ashes and charcoal, and having none of the precious articles noticable in the topes. "They are placed generally, to the north, the south or the west of the tope, but never to the east." "In Scandinavia, it is not possible to distinguish, by their form, the tombs from the more sacred monuments, but from the groups of these mounds, it is to be supposed that the most sacred monuments are the largest; and when they are opened their contents in every instance are different.' *

The interior arrangement of the topes and haugs has been already observed to be generally the same, but in the topes of Darounta, in Afghanistan, Mr. Masson observed that "the whole mass of the structure is divided into four parts, by passages intersecting each other at right angles: the passages extend the entire depth of the building, and have a breadth of five or six feet or more. Inferior tumuli do not always exhibit this peculiarity of construction, which may nevertheless be deemed genuine, and possibly prescribed, being found in the more ancient monuments."† A similar construction is noticed in the mound raised over the remains of Frey king of Sweden, which had a door and three openings forming a cross.‡

We shall now notice the relic contents of the topes and haugs. M. Holmboe says, "the articles deposited in these monuments are very much alike." In the recesses of the topes occur finely powdered earth, sand, charcoal and ashes, preserved in vases of terra cotta, stone, gold, silver, copper or iron. In one instance a wooden vase has been found. Around the vases, and sometimes within them, occur ornaments of gold, silver and copper, precious stones, various resins, small bells, gold foil, glass and crystal cylinders, and bottles con-

* Holmboe, p. 23. † *Ariana Antiqua*, p. 923. ‡ Holmboe, p. 24.

taining a brown acrid fluid, and fragments of leaves and of bark written over with the Indo-Bactrian characters. The contents of haugs include finely powdered earth, brownish sand, ocherous earth, and vases or urns of stone, iron, copper and wood, but rarely of glass, gold* or silver; containing gold coins, fragments of bones, ashes, ornaments, and of gold, silver or bronze. Various resinous and fatty matters, ingots and foils of gold, pearls, fragments of wood and bark, once a bit of birch wood, once a glass vase containing a brown rancid fluid, and at another time a glass phial containing traces of a fluid, have also been observed among the contents of haugs. Among the articles most common in topes are earthen lamps, which seem to have formed one of the principal offerings with the Buddhists to the manes of their ancestors. They have never been met with in the haugs, where their place is supplied by fragments of swords and spears. "This difference is owing, no doubt, to the bellicose propensity of the people among whom the haugs were erected." The coins found in the haugs are inferior in execution to those found in the topes, but they bear a strong resemblance to the mintage of Azes and of his successors, which have been found in abundance in the topes of Afghanistan.

Buddhist coins have generally a mystic cross *(swastika)* imprinted on them. The emblem is held in high veneration, and the Hindus have adopted it "to give to their coins, inscriptions and ceremonials a sign of benediction and happy augury," although they have no distinct conception of the manner in which it is to produce the beneficial results they seek. In the Bracteates found in Scandinavia, whether within haugs or elsewhere, we find this mystic symbol reproduced in all its entirety; and ancient sepulchral stones found in the cemetery at Gjerde in the parish of Etne, diocese of Bergen, and at Suède in the parish of Skeftuna, province of Upland, shew it with but slight variation. M. Mionnet notices this cross as a monogram of ancient Gaul, where it must have travelled with the religion of Odin before the advent of Jesus Christ.

It is uncertain if the phallic worship had ever been transported to Scandinavia, but some sacred stones found in haugs admit of a very close comparison with the *linga* of India; and the *jarkanasteen* has

* Many gold vases are said to have been found in Denmark.

been supposed to be an imitation of the Vaishṇavite *saḷígrám.* After adverting to these, M. Holmboe dwells at some length on the peculiar veneration with which the Buddhists and the Odinists hold the adoration of trees. The Bo tree of India is the prototype of the birch of Scandinavia, and we find them both as unfailing attendants of topes and haugs and equally the objects of almost divine veneration.

In the neighbourhood of topes may be noticed a large number of cells or caves which formed the dwellings of the officiating priests, who from their vicinity, in the palmy days of Buddhism in India, chanted forth their adoration to Primeval Intelligence Adi Buddha. Their counterparts are not quite so abundant in Scandinavia. Dwelling-houses there were generally built of wood and other easily perishable materials, which cannot be expected to leave traces behind them after the decay of centuries. We nevertheless find there remains of houses and caves, whose situation indicates that they must have been attached to some sacred monument. The cells around the Oushaug has been already adverted to. From them a road six feet broad and a hundred feet long, leads to two houses which most likely were at one time the domiciles of priests. A number of caverns have been noticed by Bishop Newmann in the diocese of Bergen,—a place which seems to have been at one time the head quarters of Odinism in Norway.

* "Dragons or imaginary serpents having limbs of different animals and even of man, play a prominent part in the mythology and the ornamental arts of the ancient Scandinavians. They may be seen on their Bracteates of gold and on divers ornaments of gold and silver. Even after the introduction of the Christian religion, sculptors transported figures of dragons on their household goods and on a large number of sepulchral stones; and the walls and the doors of our ancient churches had no commoner ornament than interlaced dragons.

"The serpent does not occupy a remarkable place among the animals of Scandinavia; it becomes difficult, therefore, to explain how it came to enjoy that high position on their monuments, unless we suppose it to have been borrowed from some country where it attracts a large share of attention, as is the case in

* Holmboe, p. 58.

India, which abounds in serpents, the most dangerous on account of their poison, their size, and their force. As a consequence of this abundance, the ancient legends of India are full of narrations about dragons endowed with extraordinary qualities. (According to those legends) they speak, they reason, they are their princes and princesses, they perform miracles, they unite with men in marriages, &c. &c. The Biographer of Hiouen Thsang makes mention of tanks peopled with dragons in the neighbourhood of topes; and these dragons are so pious that having metamorphosed themselves into men, they respectfully circumambulate the topes or *stupas*. The same biographer informs us that the Buddhists figured dragons on their sculptures; he mentions for example a convent at Pataliputra which had pavilions with pillars ornamented with dragons.* Among the ruins of other Buddhist towns we often find sculptures representing serpents and lizards.† In the cell of a dagoba, opened in 1820, near Columbo in Ceylon, there were found, among other ordinary articles, clay images of serpents called the *cobra di capello*.‡ The same taste for sculptures in wood representing interlaced figures which was in vogue in Norway during the middle ages, may now be seen in the Buddhist kingdom of Nepal; and we thus find at Kathmandu, the capital, near the approach of a bridge a gateway having over it a kind of coat of arms supported by two serpents."§

M. Holmboe devotes the seventeenth section of his work to the examination of a class of long narrow mounds peculiar to Tibet and Scandinavia. Dr. Thomson, in his travels in the Himalaya, noticed one of these near Leh, in the province of Ladak, which was nearly half a mile in length. "It consists," he says, "of two parallel walls, twelve or fifteen feet apart, and nearly six feet high, the intervals between which are filled up with stones and rubbish, and the whole covered with a sloping roof. * * * On the roof are laid large slabs of slate every one of which is covered with Tibetan letters, and more rarely with a rude design of a temple."‖ The height

* Hiouen Thsang, 128—51.

† Sirr II. p. 332. Ritter, *die Stupa's*, p. 210. Forbes I. p. 415—16.

‡ *Ib.* 90—91.

§ Egerton I. p. 189—190.

‖ Thomson's *Himalaya and Tibet*, p. 183.

and the breadth of these constructions are generally very much alike, but the length varies from a few feet to near half a mile. The characters represent the mystic formula *Om mani padme hum* repeated a number of times, and the construction itself is called after the second word of the formula a *Mani.* In Scandinavia these constructions have undergone but little change. In their height and breadth they are alike, and in length they vary just as much as the Tibetan Manis. Their roofs have suffered much from decay, and, in many instances, are altogether gone; and they have no inscriptions.

In the eighteenth section M. Holmboe passes on from relics to historical testimony to "prove the birth of Odinism in the bosom of Buddhism." He avails himself of the opinion started by Snorro that on the fall of Mithridates, Odin and his followers proceeded northwards from Asia to escape the Roman yoke, and that on reaching Scandinavia they supplanted the Celts who had before them taken the country from the Mongols—a race whom we now recognize in the Laplander, the Samœid and the Esquimaux. He says,*—

"The father of Norwegian history Snorro Sturlason, after having pointed out Tanaqvisl (Tanais on the Don) as the frontier between Europe and Asia, continues in these words:—

"'The country east of the Tanaqvisl was called *Asaland* (the country of Ases) or *Asaheim* (the home or native land of Ases), and the chief city in that land was called Asgard (the city of Ases). In that city was a chief called Odin, and it was a great place for sacrifice.'†

"A little after he says; 'There goes a great mountain barrier from North-east to South-west, which divides the great Svithiod from other kingdoms. South of this mountain ridge it is not far to Turkland, where Odin had great possessions.'‡ The great mountain barrier mentioned is the Caucasus, for he has said before that Svithiod was situated to the North of the Black Sea; and by the country of the Turks he alludes evidently to the country which at present bears the name of Turkistan, for he says subsequently that Odin, quitting his native home with his companions, proceeded on towards the West and arrived in Gardarike (Russia).

* Holmboe, p. 63, et seq. † *Ynglinga Saga*, Chap. II. ‡ Id. Chap. V.

"Having thus demonstrated that Snorro places the birth-place of the Ases in Turkistan, we see that Chinese, Greek and Latin writers speak of a people or of a race of Ases in the same regions. A Chinese author mentions that, in the second century before Jesus Christ, there arrived at Lo-Jang, capital of China, a Saman* of the race of Ases, who lived on the banks of the river Oxus, and who had translated the holy book which he had brought with him, and which led to the conversion of a large portion of mankiud to Buddhism.† Strabo‡ says that, among the people who, issuing forth from beyond the banks of the Jaxartes, invaded Bactria aud snatched the possessions of Alexauder's successors, the most distinguished were called the (Ασιοι) Asioi. Trogus Pompeius makes mention of the same circumstance in these words 'Sarancæ et *Asiani* Bactra occupavere,' and in another place, he calls "reges Tocharorum Asiani,"§ expressions which led M. Lassen to start the opinion that the Asii or Asiani were not the same people, but tribes of a distinguished race, from whom the kings of Tochares deduce their origin.‖ This hypothesis acquires some appearance of truth, if we suppose that it is the same name which we read on the coins with the legend ΒΑΣΙΛΕΩΣ ΒΑΣΙΛΕΩΝ ΜΕΓΑΛΟΥ ΑΖΟΥ. A great number of these coins were discovered in the topes; and they have been found elsewhere, particularly to the North and East of Peshawur, in much larger quantities than any other variety. It is worthy of remark that the coins of Azes present a greater number of types than those of any other sovereign whose coins have been found in the topes; a reason which led Mr. Wilson to suppose that they are not to be attributed to one single king, but to Azes and several of his successors who flourished in the first century before Christ and laterally.¶ The hypothesis of M. Lassen is supported by Jornandes, who says, Gothi *proceres* suos *anses*, i. e. semideos voca-

* "Saman or rather Cramaṇa, "ascetics who have subdued their senses," is a term which designates the Buddhist clergy."

† *Zeitschrift f. d. k. de Morgenl.* III. p. 121—123.

‡ Strabo I. XI. 8, 2, (p. 511).

§ Trog. Pomp. XLI. XLII.

‖ *Indische Alterthumskunde*, II. p. 360.

¶ *Ariana Antiqua*, p. 320, et seq.

vere." Now the word *ans* of the Gothic language is identical with the *ás* of the ancient language of Norway.*

"It is probably the same dynasty of which the Chinese annals make mention when they say that in the first century after Christ the prince of Kuei-Chuang, conquered all the country of the Amszus around Kabul, Kandahar and Kophen.† The same annals speak, in another place, of a people or a dynasty of *Amsi* in Soghdiana, in the first century before Christ.‡

"I hope I have now produced satisfactory arguments to prove that the Asaland of Snorro is identical with the country of the Azes, of which we have spoken above. We shall now demonstrate that Buddhism had extended into those countries in less than two centuries before Christ, and continued to be professed for several centuries after that period.

"The first powerful sovereign who embraced Buddhism was the king of India, Asoka, who reigned in the third century before Christ; and to record that event he erected pillars and large blocks of stone with inscriptions mentioning the adoption of that religion. One of these blocks has been discovered in Kabulistan. This monarch sent envoys to the Greek kings of Syria and Egypt, to obtain their permission to preach Buddhism in their dominions.

"The Chinese annals record that in the second century before our era, their general Hukiuping, when carrying on a war against the Hiungnus, met at the king of Hin-thia, to the West of the mountains of Yarkand, a gilt statue to which offerings were made;§ and the commentators of the Chinese historian Pan-ku declare that that statue was of Buddha.|| I have already shewn from those annals that in

* When the vowel *a* receives the long accent (á), in the Norwegian language, it is pronounced as *au* or *ao*, and often corresponds with the syllable *án* in the cognate languages; for *example* Sanskrit *hansa;* German, *gans;* Norwegian, *gás* "goose." The Norwegian *as* and the Gothic, *ans*, are undoubtedly derived from the Sanskrit, *ansu*, a "ray," "light," "splendour," and consequently *ansi* or *asi* means splendid, a very convenient epithet for a distinguished family.

† *Foe Koue Ki, p.* 83.

‡ A. Remusat, *Nouv. Melanges*, t. I. p. 175.

§ Lassen's *Indische Alterth.* II. p. 54.

|| *Journal des Savants*, 1854, *p.* 280.

the second century before Jesus Christ, a Buddhist priest arrived from the banks of the Oxus to China, and converted a large number of men.

"About the end of the fourth century, the Chinese pilgrim Fa-Hian proceeded towards the West, in company of some of his countrymen to search, in the words of his historian, *for the precepts of the Law*, that is to say, to learn the precepts of Buddha in the countries where he had preached them for the first time. In the course of his travels he arrived at the town of Khoten, and found that the religion of Buddha was professed there with great zeal; there were a large number of spacious and magnificent convents, some of which contained thousands of the clergy; they possessed precious images of Buddha, which they used to take about during their numerous processions, in which even their kings took a part.* After leaving Khoten he pursued his travels towards the West, and traversed the countries which we have seen to have been inhabited by the Azes, and met a number of his co-religionists.

"Another Buddhist pilgrim of China, Hiouen Thsang by name, undertook a peregrination in the seventh century with the same object as Fa Hian, that is to say, to study the doctrine of Buddha in the countries where he had preached it himself. He passed through the whole of Higher Asia as far as Bamian, among the mountains to the North of Kabulistan, and found that place to be a thriving centre of Buddhism.

"One may form some idea of the flourishing state of Buddhism in these places when he is told that the kings of Lassa in Tibet, in the seventh century, sent to the valley of Kabul for architects to erect Buddhist temples.† We see now that Buddhism flourished in those countries before the period when Odin forsook his native land to establish himself among the ancestors of the Scandinavians, and the topes attest that the profession of Buddhism was continued for several centuries.

"The true situation of *Asgârd* will no doubt remain unknown

* *Foe Koue Ki* and *l'Histoire de la Ville de Khoten*, traduit du Chinois par A. Remusat, Paris 1820.

† Sanang Seetsen, *Geschichte der Ost Mongolen von I* Schmidt, St. Petersburgh 1829; Abschan II. *Tibelische Geschichte*, p. 41.

until the epoch of Odin's emigration is thoroughly ascertained. It appears to me that the name Asgárd is identical with *Asagarta* of the Bisóutoün (Bagistana) inscription, which in the enumeration of the provinces which belonged to the monarchy of Darius is named immediately above Parthia. M. Lassen thinks that we should search for Asagarta to the West of Parthia. If, on the contrary it be situated to the East of that country, the situation will accord better with the countries which we have found as those of Azes. Asgárd is perhaps an oriental name slightly altered to confirm to the rules of the Norwegian language. The words *gard*, *guer*, *kart*, *kert* are met with in most Arian languages, with the same signification which *gárd* has in the Norwegian, for instance in Persian Darabguerd means the town of Darius."

Allusion has already been made to the similitude of the words Buddha and Odin. M. Holmboe says that "the arguments both for and against the identity of the two words are too weak to lead to a conviction." He adds, however, that "it is to be presumed that the most illustrious of the missionaries who proceeded to the North must have borne the name of Buddha or at least some epithet derived from the Sanskrit root *budh* "Intelligence," "knowledge," for example *bodhan*,* or *bodhant*, participle present of the verb; and from that the Scaudinavians may have formed their *Odin* and the Germans their *Wodan*. The transition of the letter *b* to *v* still occurs in the Sanskrit itself, and in the Hindustani and Bengali which are derived from it, the difference is entirely lost. The omission of the first letter in the name of Odin is conformable to the rules of the ancient language of Norway, in which *v* is often elided before the labial vowels *o* and *u*. The German appellation Wodan accords more with the nominative masculine of the present participle *bodhan*, and this accordance becomes the more striking when it is considered that in a glossary on the work of Jonas de Bobbio, this word is written *Vuotant*;† thus answering for the oblique cases of the participle present

* The form *Bodhin* enters at least in the name of the sacred tree, which is sometimes called *Bodhin Wahanoa*. Ritter, *die Stupa's* p. 161, Forbes p. 213.

† Gimm *Deutsch. Mythologie* 2te Ausg, p. 120.

Several conjectures have been proposed about the derivation of the name Oden or Wodan: for example from the Gothic *Wods* or Norwegian *Odr*, "enraged," or,

of *bodhant.* The hypothesis about the identity of the name of Odin with Buddha or with some word derived from that root, is likewise proved by the name of Wednesday, which, in Scandinavia bears the name of *Onsdag*, a contraction for *Odins-dag* "the day of Odin," as in Sanskrit *Buddhavára* "the day of Buddha," and in Hindustani, *budh-bar.*

"It may perhaps be objected to this identification that, in the annals of Norway, Odin is represented as a warrior and not as a preacher, and that the warlike life of the worshippers of Odin little accords with the mild and pacific doctrines of the Buddhists. But we find from the fragments of swords in religious places that such an alliance in the beginning of Buddhism was not very astonishing; and, on the other side, it must be remembered that the Buddhic religion has its esoterics very different from its exoterics, and that according to the Chinese annals, the people of the North accepted only the last, i. e., the morality and mythology, as they were the most conformable to their nomadic habits and warlike propensities.* The circumstance, lastly, that not only Odin himself but several other Azeses' having been elevated to the rank of gods, justifies the supposition I make that they enjoyed a religious veneration during their existence. Odin was probably, as Buddha, placed at first among the inferior gods, and subsequently among the superior gods, until at last he was recognized as their chief. That which evidently proves that a long time passed before Odin attained the supreme rank is the fact, remarked by Adam of Bremen, that in the temple of Upsala the image of Thor occupied the place of honor in the centre between Odin and Fey."†

as suggested by Grimm, from the Old German *Watan* or Norwegian *Vada* "go and walk."

* *Foe Koue Ki* p.12. The biographer of Hiouen Thsang likewise speaks frequently of *warlike* Buddhists; thus at page 278, after mentioning that the people of Khoten profess a great respect for the law of Buddha, he adds: "The king is brave, prudent, *warlike*, and full of respect and affection for virtuous men." Again at page 382, it is said of the king of Ho-tan (Khoten): "The king is very *warlike*, and bears a profound respect for the law of Buddha."

† Grimm. *Deutsch Mythologie 2te Augs.* 146.

PROCEEDINGS

OF THE

ASIATIC SOCIETY OF BENGAL,

For November, 1857.

The monthly general meeting for November was held on the 4th instant.

The Hon'ble Sir J. Colvile, Kt., President, in the chair.

The proceedings of the October meeting were read and confirmed.

A presentation was received from the Royal Observatory, Greenwich, of a copy of "Tables de la Science, construites d' apuis le Principe Newtonien de la Gravitation Universelles," by P. H. Hassen.

The appointment of Captain C. H. Dickens and Mr. Cowell as members of the Council, in the room of Dr. Spilsbury and Archdeacon Pratt, was confirmed.

The election of Mons. Robert Schlagintweit as a corresponding member of the Society, was again postponed, under rule 6 of the Society's Bye-laws.

A note from Captain Haughton, withdrawing from the Society, was recorded.

Communications were received.—1. From Mr. H. Piddington, a paper on the spontaneous combustion of Coal.

2.—From Mr. B. H. Hodgson, C. S., a description of a new species of Himalayan Mole—*Talpa microura.*

3.—From the same gentleman, a series of Vocabularies, &c., as named in the following extract from his letter, dated 9th October last.

"I am sending you by post through the Bengal Secretary, A. R. Young, Esq., four big letters, containing two series of Vocabularies, each in two parts, being, 1st those of the broken tribes of the

Central Himalaya, and 2nd, the dialects of the Great Kiranti language, and further, an ample and careful dissection of one of the former class of languages. These will in a few days be followed by a similar dissection of one of the above dialects of the Kiranti tongue. All these tongues are of high interest, as I think will be sufficiently apparent from the grammatical analysis of one of each group, viz., the Vaya tongue of the former, and the Baking of the latter class, and I think Müller and Caldwell will be now satisfied that they were very premature in asserting that there is nothing Dravidian in the Himalayan tongues.

"The Vocabularies were prepared long ago, and ought to have been sent, but when I got into the work of grammar analysing, I of course saw faults in the first crude work, and those I purposed to correct ere the Vocabularies were printed, but life is short, science long, and I must be content to leave the Vocabularies as they are, while I go on with my complete examination of such few of the whole of these tongues as seem to me most important in themselves and most likely to illustrate the class they belong to; I wish I could have had a little more time both for vocabulary and for complete analysis."

4.—From Lieut.-Col. R. Strachey, Secretary to Government, Central Provinces, the following account of the old Fort of Bilheree near Jubbulpore, by Capt. D. C. Vanrenen, Arty.

A description of the old Fort of Bilheree, situated about 56 miles N. N. West of Jubbulpore, which was destroyed in the month of August, 1857, *by Captain Vanrenen of the Artillery, by order of Major Erskine, Commissioner, Saugor Division.*

The old Fort of Bilheree, which was built by Luchmun Singh Pudhae Chutree in A. D. 1489, consisted of a square redoubt with a side of 234 feet and circular projecting towers at each corner, their diameter being 14 feet, and octangular bastions, one on each side of the principle gateway. A high wall to the north, of irregular outline, with corner towers, which following the line of an impassable swamp, was connected to the main work by a curtain wall, at the north west corner. It was bounded on the North and East

by an unfordable tank and swamp, and save a small clear space in front of the principal gateway, it was further protected both on the West and South by a deep ditch, its average depth being 12 feet and breadth nearly 30 feet.

The walls of the square redoubt, were about 40 feet high, and 4½ feet thick, the bastions being 10 feet higher, and the whole was carefully loopholed for musketry fire. The fire through these loopholes was obtained from the roof of a line of buildings, or verandah, open at the rear. This banquet was of great solidity, being supported on cut stone pillars. Single stone slabs spanned these pillars, which were faced with lime cement.

The northern wall, facing the jheel, was about 25 feet high, with a thickness of 3 feet; immediately in rear and adjoining it was another wall 5 feet thick, and of a height sufficient to give a musketry fire over the outer wall. The curtain wall connecting this with the square redoubt, was 18 feet high and 5 feet thick.

All the works were of immense strength being of stone and lime cement, and when I visited them, they were found to be in excellent preservation.

Part of the works, consisting of a curtain wall outside of the western ditch, as also the detached buildings within the redoubt and northern wall, had been subsequently built by the Mahrattas, these being less breached and injured.

Besides the principal gateway (opening out to the south) there were two others leading into the main body of the redoubt, one to the North, and one to the West. There was also an entrance way in the North West curtain wall.

The interior arrangements were very complete. The open colonnade, with a few interior apartments, would have afforded ample cover for a large body of men, with space for their supplies. Water was obtained from a pucka well within the works, with an additional supply from the eastern tank, by means of a flight of stone steps leading down to it.

Bilheree Fort boasted of an *Aamkhass*, or Audience Hall, which with some interior apartments, occupied a space of 78 feet by 51 feet. This was a fine hall of elegantly shaped stone pillars, supporting a roof also of stone slabs and lime cement.

Situated in nearly the centre of the redoubt was the Ranee's or Queen's apartment, a two-storied building 78 feet by 68 feet. This and the *Aamkhass* were of the most solid construction.

A place of worship was provided (contained within a rectangular enclosure) in front of the *Aamkhass.*

From the above it will be gleaned that a few resolute men, supplied with provisions, could have held these fortifications for a considerable period, and against large numbers.

The walls would have successfully resisted the action of field guns. They were very scientifically loopholed, and with great care.

The key to the position was evidently by the principal gateway. Without guns of some calibre the place was unassailable from the north and east, and (unless the attacking party first occupied the town of Bilheree, which is within range of musketry fire) it was unassailable from the West; bearing this in mind, whilst I have endeavoured to render the whole of the works untenable, and uninhabitable, the work of destruction is more complete on the southern and south western face than elsewhere, the walls of which have been nearly levelled, and the deep ditch, as far as the first causeway, filled up, towards Jubbulpore.

(Signed,) D. C. VANRENEN,
Capt. Artillery and Revenue Survey.

The 30*th October*, 1857.

Statistics in reference to the old Fort of Bilheree, translated from papers in the possession of MUNDLAH RAM, *Ex-Kanoongoe of Bilheree.*

The Fort of Bilheree was built in the year A. D. 1489 by Luchmun Singh Pudhar Chutree, who held a Jagheer from the Nagode Rajah, consisting of 300 villages, which now constitute Pergunnah Bilheree.

Luchmun Singh, his son and grandson continued in possession of the Jagheer for 70 years, or until 1559, when it was taken by stratagem by a Gond Rajah named Mugroo Dooj; who had married the granddaughter of Luchmun Singh. The Gonds held

this Jagheer under the Mundlah Chieftain for 115 years; when on failing to pay the taxes levied on them by the Mundlah Rajah, the whole Jagheer was taken from them by the Mundlah Rajah, and by him made over to Juswunt Rao Mahratta, in the year A. D. 1674.

Juswunt Rao, assisted by 300 Sowars, held the government under the Mundlah Rajah, and on his death was succeeded by his son Moonga Rao, who reigned 78 years.

The Mundlah Rajah at that time, A. D. 1742, was at war with the Nagpore Rajah, and, suspecting Moonga Rao of treachery, caused him to be put to death and the Jagheer to be transferred to his favorites Nawab Ajeet Khan and Ahmud Khan, who had it on the same terms as Juswunt Rao. On their deaths in A. D. 1767 the Jagheer lapsed to the Mundlah Rajah, who managed it on his own account, and derived a yearly revenue of 20,000 Rupees.

The Mundlah Rajah was in his turn ousted by the Sagur Rajah, Bulwant Rao Pundit, in the year A. D. 1779 who again was deprived of the Sovereignty by Raghojee of Nagpore, from whom we took the country in the year A. D. 1816.

(Signed) D. C. Vanrenen, *Capt. Artillery,*

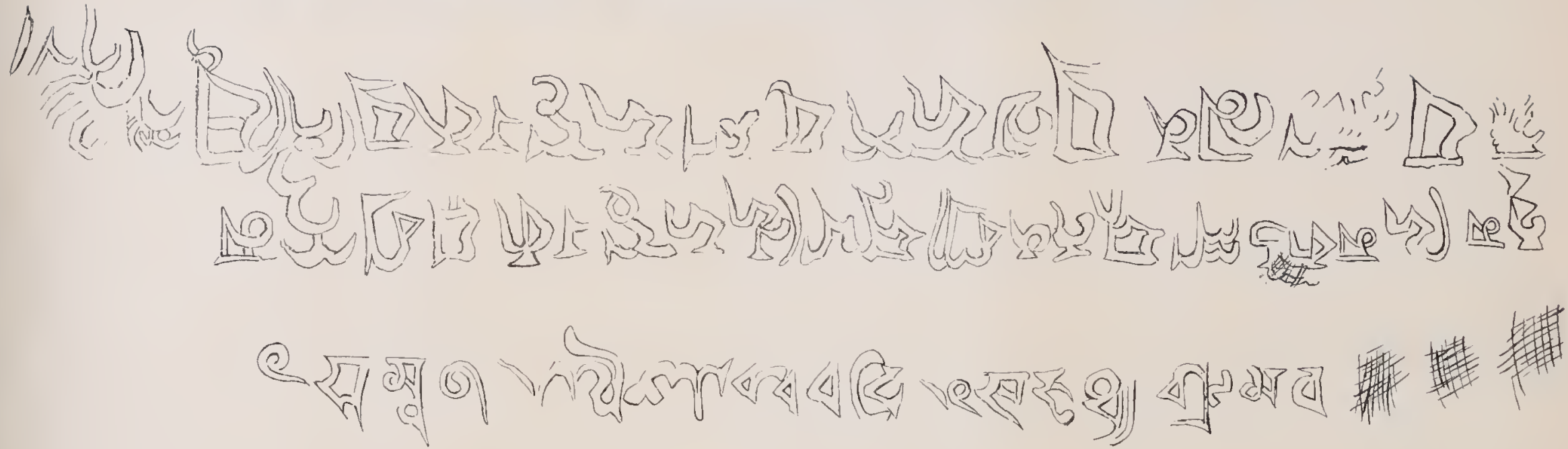
Jubbulpore, Revenue Surveyor's Office, the 3rd October, 1857.

5th.—Bábu Rájendralál Mitra read the following note on a stone bull found at Buddha Gaya and bearing a Sanscrit inscription, dated 781 of the Samvat era.

Note on a Stone Figure of a Bull from Buddha Gayá.

I am indebted to Mr. Grote for an opportunity of examining an interesting figure of a bull couchant with a Sanskrita inscription on its back, bearing date 781 of the Samvat, corresponding with 725 of the Christian era. It is an alto-relievo, and measures about 12 inches in height, the length being from the croup to the root of the neck 16 inches; the head is mutilated. Around the back is a string of bells, and the neck is bedecked with a variety of beaded ornaments. The figure is said to have been brought from Buddha Gaya, but had this information been wanting, the material (basalt) and the style of sculpture would have left little doubt as to the place of

FACSIMILE OF AN INSCRIPTION ON THE FIGURE OF A BULL FOUND AT BUDDHA GAYA.



T. DELICA, LITHR. 4 WATERLOO ST. CAL: 1858.

its origin. The inscription is in the well-known Kutila characters, and records that the bull was consecrated by Srí Suphandi Bhattáraka son of Bhimakaullá, for the purpose of securing progeny. The language is simple, but owing to mutilations, two or three words are not legible. The second figure of the date is indistinct, and the word Samvat has the final consonant wanting, which is owing perhaps to an accidental omission on the part of the engraver, or more probably to a fondness for abbreviation, as I have noticed a similar omission in two or three other inscriptions. In the present day the word is generally written without the last two consonants and their intermediate vowel.

The subject of the inscription offers little for comment. The practice of dedicating bulls either alive or in effigy to secure progeny is a matter of no interest to the antiquarian, while the individual who consecrated the bull is not an historical personage; but the circumstance of the Kutila character being used in an inscription of the 8th century, affords an important subject for the consideration of the Indian Archæologist.

The absence of dates in many of the inscriptions found in India led the late Mr. James Prinsep to devise a system of palæographic chronology in which the style of the writing was taken as an index to the age of the document in which it was found. The system was matured after a careful examination of a large number of ancient inscriptions and coins, and recorded in a table (ante vol. VII. p. 276, plate xiii.) in which different centuries have each a particular set of characters assigned to it. According to this table the Kutila characters are placed against the 9th century. It is evident, however, that Mr. Prinsep intended his table to be merely tentative, and open to considerable corrections and modifications; for it is difficult to believe that he would take each particular set of characters to belong to one particular century and no more, or that the same character should be common over all the Sanskritic Cis-Vindhyan regions for a given period. Nothing is more common than a single style of writing spreading over two or three centuries, or predominating in certain regions, while it is dying out in others. The history of the English and the German characters affords a singular instance in point. Mr. Prinsep was fully aware of this, and has accordingly assigned

a range of three centuries to his No. I, or Lat characters, and of four centuries to No. IV. of the Guzerat plates.

Later chronologists have, however, missed the spirit of his table, and have used it in such a manner as to lead to serious mistakes. A distinguished antiquarian has lately taken so narrow a view of the table in question, as to argue an inscription* to be of the 10th century simply because it happened to be in a character very near the Kutila, without making any allowance for the range which that character must have had, the locality where the document was found, or the date which it bore. This, in our humble opinion, is a very unphilosophical mode of drawing conclusions. The inscription now submitted, compared with such inscriptions of this type as have been already published, will shew that the Kutila characters were current over a large tract, for upwards of four centuries.

The era of the document is Samvat, but whether of the sovereign of Oujjein or of Balhabi or of the Pál Rájás of Bengal, does not appear. It may, however, be very reasonably taken to be that of Vicramáditya, considering that the Balhabi Samvat did not extend much beyond Rájputáná, and the Pála Samvat would bring down the inscription to a period when the Kutila had been entirely superseded by the modern Deva Nagari.

The following is a transcript of the inscription.

ए सम्व ७८१ वैशाखवदि ९ षरुध्य ग्रामव × × × त्तम भिमक उल्ला सुतेन श्रीसुफ-
न्दि भट्टारक ञ्च (?) य (?) त्तमतया × × त्मनपत्यदेतो दृषभट्टारक प्रतिष्ठ-
तेति ॥

R. M.

* I have now in hand a paper on the era of Bhoja, in which the claims of this inscription will be discussed in detail.

ERRATA.

Page 76 line 23 for वेशाश्व वदि *read* वैशाख वदि
" " " 24 for दैतो *read* हेतो

For December, 1857.

The Monthly General Meeting for December, was held on the 2nd instant.

Major H. L. Thuillier, senior member present, in the Chair.

The proceedings of the November meeting were read and confirmed.

Presentations were received—

1st.—From the Royal Academy of Sciences at Berlin, the latest publications of the Academy.

2nd.—From the Bombay Government a copy of the Magnetical and Meteorological Observations.

3rd.—From Rája Shib Chunder Devá, Báhádur, a copy of his treatise on Infant Treatment in Bengali.

The election of Mons. R. Schlagintweit as a corresponding member of the Society was once more postponed under rule 6 of the Society's bye-laws.

Babu Kaliprasanná Sing, was proposed for ballot at the next meeting by Babu Rajendralal Mittra, and seconded by Mr. Grote.

Communications were received—

1st.—From Babu Radha Nauth Sikdar, an abstract of the Meteorological Observations made in the office of the Surveyor General during July last.

2nd.—From Dr. G. von Liebig a paper entitled "Discussions of some Meteorological Observations made on Parasnath Hill."

3rd.—From Mr. Grote a letter, of which the following is an extract, referring to the Tertiary fossils in the neighbourhood of Kohat, presented to the Government Geological Museum by Dr. Garnett.

"An interesting letter was read by Professor Oldham at our June meeting of 1856, in which Lieut. Garnett of the Engineers described the country near Kohat, where Lieut. Trotter's fossils had been found. Lieut. Garnett asked for information about the specimens which had been sent down to the Society, and apparently also

to Professor Oldham. I have now a letter from Dr. Falconer, in which he tells me for communication to the Society that among the fossils sent to Mr. Oldham he has identified—

1st.—A species of *Dinotherium*, probably new.

2nd.—A species of a genus closely allied to *Tapir*, new to the Indian Fossil Fauna.

3rd.—*Amphicyon*, a species of a large carnivorous form, as heavy as the Polar bear. The genus occurs in the European Miocenes along with Dinotherium.

The specimens which Dr. Falconer has seen, are, he says, very imperfect. It might be worth while to consider at the next meeting, whether it would not be well for us to send home our specimens, should they be better than Mr. Oldham's, and get them described and returned to us."

Resolved, that Mr. Grote's suggestions be referred to the Council, with power to do what they thought best in the matter.

Bábu Rájendralál Mitra read a paper on the traces of Buddhism in Norway in which he represented that the Odinic relics in N. W. Europe bear a strong similitude to the material remains of Buddhism in India, and that that similitude is attributable to a community of idea and design. The subject was illustrated by several drawings prepared by the boys of the Government Wards' Institution.

On the motion of the Chairman, the thanks of the meeting were accorded to the Bábu for his able and interesting paper.

The Librarian and the Zoological Curator submitted their usual monthly reports.

Library.

The Library received the following accessions during November last.

Presentation.

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin, 1855, *Berlin*, Royal 4to.—By the Prussian Academy of Sciences.

——— Ditto ditto, Erster Supplement—Band, 1854, folio.—By the Same.

Monatsbericht der ditto ditto, from July, 1855 to October, 1856, 8vo. —By the Same.

The Transactions of the Linnean Society of London, Vol. XXII. Part I.—By the Linnean Society.

Journal of the proceedings of the ditto, Vol. I. No. 3.—By the Same.

Address of Thomas Bell, Esq. President, read at the Anniversary of the Linnean Society on Saturday, May 24th, 1856, *pamphlet.*—By the Same.

List of the Linnean Society of London, 1856, *pamphlet.*—By the Same.

Report (33rd Annual) of the Royal Asiatic Society of Great Britain and Ireland.—By the Society.

The Quarterly Journal of the Geological Society, Vol. XIII. Part I. No. 49.—By the Society.

Transactions of the Geological Society of London, Second Series, Vol. VII. Part 4th, 1856.—By the Society.

The Journal of the Royal Geographical Society, Vol. XXVII. 1856, 8vo.—By the Society.

The Journal of the Statistical Society of London, Vol. XX. Part III. —By the Society.

List of Fellows of the Statistical Society of London up to 30th June 1857.—By the Society.

Zeitschrift der Deutschen Morgenländischen Gesselschaft, Vol. XI. Heft. 1 to 3.—By the German Oriental Society.

The Geological Papers on Western India, 8vo. with an Atlas.—By the Bengal Government.

The Oriental Christian Spectator for October, 1857.—By the Editor.

The Calcutta Christian Observer for November, 1857.—By the Editor.

The Oriental Baptist for ditto.—By the Editor.

Magnetical and Meteorological Observations made at the Hon'ble East India Company's Observatory, Royal 4to. Bombay, 1856.—By the Bombay Government.

The Vividhártha Sañgraha, No. 42.—By Ba'bu Ra'jendrala'l Mitra.

La Poésie Philosophique et Religieuse chez les Persans d'apres le Mantic Uttaïr ou le Langage des Oiseaux de Farid-Uddin Attar, par M. Garcin de Tassy, *Paris,* pamphlet.—By M. Garcin de Tassy.

Note sur les Rubâ'iyât de 'Omar Khaïyâm, par M. Garcin de Tassy, *pamphlet.*—By the Same.

Exchanged.

Athenæum for August, 1857.

The London, Edinburgh and Dublin Philosophical Magazine and Journal of Science for September, 1857, No. 92.

Annalen der Chemie und Pharmacie for July, 1857.

Purchased.

Grimm's (Dr. Jacob) Deutsche Grammatik, Vols. I. to IV. 8vo. *Gottingen*, 1822.

——————— Geschichte der Deutscheu Sprache, Band I, Zweite auflage, 8vo. *Liepzig*, 1853.

——————— und Wilhelm Grimm, Deutsches Wörterbuch, Band I. and parts 1 to 4 of Band II. 4to. *Liepzig*, 1854.

——————— Deutsche Mythologie, Band I, Dritte Ausgabe, 8vo. *Gottingen*, 1854.

Mémoirs sur les contrées occidentales, traduits du Sanscrit en Chinois, en l'an 648, Par Hiouen-Thsang, et du Chinois eu Francais par M. St. Julien, Tome I. Royal 8vo. *Paris*, 1857.

Ramayana (रामायण) Poema Sanscrito di Valmici traduzione Italiana con note per Gaspare Gorresio, *Paris*, Vol. IX. Royal 8vo. 1856.

Mémoires de l'Académie Impériale des Sciences de Saint-Petersbourg, Six Series, Tome VII. 1st and 2nd Livraison.

Rig-Veda oder die heiligen Lieder der Brahmanen. Herausgegeben von Max Müller, Zwiete Lieferung 4to. *Liepzig* 1857, *pamphlet.*

Analectes sur l'Histoire et la Littérature des Arabes D'Espagne, par Al-makkari. Publiés par M. R. Dozy, G. Dugat, L. Krehl et W. Wright, Tome I. Seconde Partie, 4to. *Leyde*, 1856.

Catalogue of Lepidoptera in the collection of the British Museum, Part I. *Papilionidæ. London*, Royal 4to. 1852.

Catalogue of Shield Reptiles in ditto, Part I. *Testudinata* (Tortoises), by J. E. Gray, 1855.

Bowring's (Sir John,) Kingdom and People of Siam; with a Narrative of the Mission to that country in 1855, 2 Vols. 8vo. *London*, 1857.

List of the Specimens in the Collection of the British Museum, 12mo. *London*, 1852.

Literary Gazette, Nos. 2117 to 2121.

Journal des Savants for August, 1857.

The Annals and Magazine of Natural History, No. 117.

Revue et Magasin de Zoologie, No. 7, 1857.

Revue des Deux Mondes, 15th August and 1st Sept. 1857.

Comptes Rendus, Nos. 5 to 8, August, 1857.

GOURDAS BYSACK,
Librarian and Asst. Secy.

1st December, 1857.

Report for December Meeting, 1857.

The only donations which I have at present to report upon are as follows—

1. Bábu Rájendra Mállika. The carcass of a fine *Bára Sing'ha* buck (CERVUS DUVAUCELEI), the skin of which has been since mounted; and ditto of the common large Squirrel (SCIURUS ELPHINSTONEI), prepared as a skeleton.

2. C. B. Chalmers, Esq. 44th B. N. I. A fine skin of the MENURA SUPERBA, or 'Lyre-bird' of N. S. Wales; since mounted.

3. J. Sweeny, Esq. An example of PYTHON MOLURUS, 13½ ft. long; obtained in the neighbourhood, but not improbably escaped from confinement.

4. From myself, the carcasses of two *Chitas* (FELIS JUBATA), both skins and one skeleton set up;* of a *Sia-gosh* (F. CARACAL); Bear (URSUS LABIATUS); and large MONITOR DRACÆNA, the skeleton of which has been set up. Also a number of fishes, procured at the Sandheads: and, by purchase, an enormous skull of URSUS ISABELLINUS, and one of U. TIBETANUS.

In a native shop where the latter were obtained, I found a large bag of Feline tusks or canine-teeth, comprising (at the lowest computation) those of about 250 Tigers and 150 Leopards. I have selected a fine series illustrative of the growth of the teeth, and of the magnitude attained by them.

I have also purchased, alive, but it has since died and been transferred to the museum, a very rare Parrakeet, the PALÆORNIS ERYTHROGENYS, nobis (nec Lesson, nec Fraser), v. *P. nicobaricus*, Gould, and *P. barbatus* apud Pucheran (*Rev. Zool*, &c. 1856, p. 209). *P. erythrogenys* of Lesson was pre-applied, but is merely a synonym of the common P. LONGICAUDA (v. *malaccensis*, and the young—*P. viridimystax*, nobis, *J A. S.* XXV, 446); for which reason Mr. Gould's name *nicobaricus*, bestowed under the impression that *erythrogenys* of Lesson was a particular species, cannot be accepted. *P. erythrogenys* of Fraser, again, is not only subsequent to ERYTHROGENYS, nobis, but bears the prior synonym of *Luciani*, J. Verreaux; and this bird appears to me to be the original BARBATUS of Gmelin,—*habitat* unknown, but probably from Cambodia or Cochin-

* The following mounted skeletons of FELIS were exhibited at the Meeting. F. LEO (N. Africa); F. TIGRIS (enormous); F. PARDUS; F. JUBATA; F. CARACAL; F. CELIDOGASTER (v. *viverrina*); F. BENGALENSIS; F. CHAUS; and Indian F. DOMESTICA.

China (and to the same little explored region most probably appertains the P. DERBIANUS, Fraser). The specimen of P. ERYTHROGENYS now exhibited was imported from Singapore, but was doubtless originally obtained from the Nicobar Islands by Malayan traders, no other *habitat* being at present known for this fine species. The specimen was a female, and is the only example of that sex which I have yet seen; those formerly supposed to be females being evidently young males. The female differs from the male in having a conspicuously smaller bill, of a blackish colour, whereas the upper mandible of the male is coral-red; though perhaps old females may have the upper mandible red as in the male, as commonly in P. JAVANICUS, (Osbeck, v. *Osbeckii*, Latham, v. *mystaceus*, Shaw, &c.,—*ponticerianus*, Gmelin, being a misnomer),—and always, I think, in P. LONGICAUDA; the head, nape, and upper-parts, are also much more uniformly green; and the red of the cheeks is less intense. This handsome species is figured in the 9th part of Mr. Gould's splendid 'Birds of Asia,' together with P. CANICEPS, nobis, and P. BARBATUS, (Gmelin, v. *Luciani*, J. Verreaux). We have now both male and female of P. ERYTHROGENYS, mounted from fresh specimens in good plumage that had died in captivity.*

December 2nd, 1857. E. BLYTH.

* I subjoin a synopsis of the species of this genus with their synonyms, according to latest information.

1. P. ALEXANDRI; *Psittacus Alexandri*, L.: *Ps. eupatria*, L., et *Psittaca ginginiana*, Brisson,—the female; *Psittacus guinneensis*, Scopoli (nec *guineensis*, Gmelin); *Ps. Sonneratii*, Gmelin; *Pal. nipalensis*, Hodgson. Figured in Edwards's Birds, pl. 292. Inhabits the hilly regions of all India proper, from the sub-Himaláyas to Ceylon inclusive; with those of Asám, Sylhet, Arakan, and the Tenasserim provinces,—except southward, as in Tavoy and Mergui. The ordinary Parrakeet of the Punjáb generally. The very young are brought in considerable numbers to Calcutta, the earliest towards the close of February; and many old birds also, chiefly from the Midnapur jungles, as I am assured: and according to Buchanan Hamilton *(MSS.)*, flocks visit the neighbourhood of Calcutta when the crop of rice is ripe. These doubtless come from the hilly country westward of the delta; and, I suspect, return to their distant roosting-places in the hills towards sunset (for the birds of this genus are apt to roam thus over a vast extent of territory). Though figured by Sonnerat from the Philippines, it is probably only known there in a captive state.

2. P. TORQUATUS; *Psittaca torquata*, Brisson (*Psittacus torquatus*, Gmelin, in part): *Psittacus steptrophorus*, Desmarest; *Ps. cubicularis* (?), Hasselquist; *Ps. docilis* (?), Vieillot; *Pal. Layardi*, Blyth (var.): *lutino* variety.—'Sulphur Parrakeet,' Shaw. Inhabits the plains of all India, in great abundance; also Ceylon, but is rarer eastward of the Bay of Bengal, though found (sparingly ?) as

far southward as Province Wellesley. In Africa found from Abyssinia to Senegal, where stated by the late H. E. Strickland to be "identical with specimens from India." Col. Chesney also notices this species in Syria, as abounding in the spring *(Journal of Euphrates Expedition*, I, 443, 537). But Swainson states that Senegal specimens are smaller, with closed wing "not quite 6 in." In India the ordinary length of wing is 6½ in., and in fine old males 7 in. The late Prince of Canino would separate "the race of Senegal" by the name P. DOCILIS, (Vieillot). *Comptes Rendus*, March 1857.

3. P. BITORQUATUS; *Psittacus bitorquatus*, Kuhl: *Ps. bicollaris*, Vieillot; *Pal. borbonicus*, C. L. Bonap. Inhabits Mauritius and Bourbon.

4. P. COLUMBOIDES, Vigors: *P. melanorhynchos*, Sykes (nec Wagler), the female or young. Figured in *Madr. Journ.* XI, 209, and in Jerdon's 'Illustrations of Indian Ornithology,' pl. XVIII. Inhabits the Nilgiris and Malabar ghâts.

5. P. CALTHRAPÆ, Layard: *P. Gironieri*, Verreaux; *P. viridicollis*, Cassin. Peculiar to the mountain region of Ceylon; being the only species met with at Newera Elia.

6. P. SCHISTICEPS, Hodgson: *Conurus himalayanus*, Lesson. Common in the middle and lower region of the Himaláya, extending eastward to the Kás'hya hills, where also common; but never seen in the plains. Westward, the late Dr. Griffith observed it in flocks at Pushut. Captive specimens are not unfrequently brought to Dacca, but seldom to Calcutta.

7. P. CYANOCEPHALUS; *Psittacus cyanocephalus*, L. (the female): *Psittaca bengalensis*, Brisson; *Psittacus signatus*, Scopoli; *Ps. erythrocephalus*, Gmelin; *Ps. ginginianus*, Latham; *Ps. rhodocephalus*, Shaw: *lutino* var.—*Ps. narcissus*, Latham (with coloured figure): *Ps. flavitorquis*, Shaw, *Ps. annulatus*, Kuhl, and *Pal. flavicollaris*, Franklin,—the female. Figured in Edwards's Birds, pl. 233. Inhabits the upland jungle districts of all India proper, with Ceylon, Asám, Arakan, and the Tenasserim provinces; replacing in the lower hills, for the most part, the P. TORQUATUS of the plains. When the rice is ripening, flocks visit the neighbourhood of Calcutta; but probably return to their hill roosting-places by sunset, however great the distance. Though figured by Sonnerat from the Philippines, it is probable that captive specimens only are there known; and the same with China. Immense numbers are taken from Calcutta in the shipping.

The rest of the genus have a broad black moustachial mark, and constitute the *Belocercus* of the Prince of Canino.

8. P. CANICEPS, nobis. Figured in Gould's 'Birds of Asia.' A male obtained in the Nicobars, and a female in Province Wellesley; the only examples as yet known.

9. P. JAVANICUS; *Psittacus javanicus*, Osbeck: *Ps. bimaculatus*, Sparrman; *Ps. pondicerianus* et *Ps. borneus*, Gmelin; *Ps. Osbeckii*, Latham; *Ps. mystaceus*, Shaw; *Pal. melanorhynchos*, Wagler (nec Sykes), et *P. nigrirostris*, Hodgson,—the female; *P. modestus*, Fraser,—the young. Figured in Swainson's *Zool. Ill.* 2nd series, pl. 16. The most common species of the Indo-Chinese countries generally; but not seen wild on the western side of the Bay of Bengal (though *pondicerianus* is one of its synonyms); neither, according to Dr. S. Müller, does

it inhabit Borneo (though *borneus* is another synonym); though common in Java. It also abounds in Sylhet, Asám, and Nepâl; and inhabits the Rajmahl hills, resorting in great flocks to the neighbouring plains when the crops are ripening. Buchanan Hamilton observed them "in the woods near Gorruckpore." Vast numbers are obtained by the Calcutta bird-dealers, even when very young; which are brought from Tipperah and Chittagong, as I am assured. Javanese specimens are undistinguishable from Indian.

10. P. DERBIANUS, Fraser. *Hab.* —— ?

11. P. BARBATUS; *Psittacus barbatus*, Gmelin: *Pal. Luciani*, J. Verreaux; *P. erythrogenys*, Fraser; *P. Fraseri*, Moore. Figured in Gould's 'Birds of Asia.' *Hab.* —— ?

12. P. ERYTHROGENYS, nobis: *P. nicobaricus*, Gould; *P. barbatus* apud Pucheran. Figured in Gould's 'Birds of Asia.' Peculiar to the Nicobar islands where an abundant species.

13. P. LONGICAUDA; *Psittacus longicauda*, Boddaert: *Ps. malaccensis*, Gmelin (nec Brisson, nec Latham); *Ps. erubescens*, Shaw; *Ps. ginginianus*, var, C. Latham; *Ps. barbatulatus*, Bechstien; *Pal. erythrogenys*, Lesson (nec Blyth, nec Fraser); *P. viridimystax*, Beilyth,—the young. Figured by Levaillant, pl. 72. Inhabits Sumatra, Borneo, and the southern portion of the Malayan peninsula, —being the only PALÆORNIS there met with, and having the same range of distribution as PSITTINUS MALACCENSIS and LORICULUS GALGULUS; these three being the only known Parrots that inhabit that range of territory! and in Java there are only PAL. JAVANICUS and LORICULUS VERNALIS, both of which are also common in the Burmese countries.

I add the synonyms of

14. PSITTINUS MALACCENSIS; *Psittacus malaccensis*, Latham (nec Brisson, nec Gmelin): *Ps. incertus*, Shaw; *Agapornis azureus*, (Temminck), Bonap., *passim; Psittacula reticulata*, Lesson. Figured in Swainson's *Zool. Ill.*, 1st series, pl. 154. Barely separable from PALÆORNIS, but has a short even tail. Has the same range of distribution as PAL. LONGICAUDA and LORICULUS GALGULUS.

For January, 1858.

At the Annual General Meeting of the Society, held on the 6th January 1858.

Hon'ble Sir James Colvile, Kt., President, in the Chair.

The Secretary read the following

Report for 1857.

The Council regret that, in submitting their annual report for 1857, they cannot congratulate the Society upon the state of its affairs. The troubles into which the country has been plunged have to serious extent interfered with the Society's progress and prosperity.

The rolls exhibit a sudden decrease of 22 ordinary members resident in India, the total at present being 109, whereas it was 131 at the same period of last year. The elections during the year have been only 6, while the loss amounts to not less than 26, of which 14 have been caused by retirement, and 12 by death. The Society now includes 147 members, of whom 38 are absent in Europe.

	Ordinary.	Paying.	Absent.
1851	130	124	6
1852	139	122	17
1853	146	123	23
1854	155	129	26
1855	162	128	34
1856	167	131	36
1857	147	109	38

Mr. John Nietner, of Colombo, Ceylon, has been elected a corresponding member during the period under review.

Obituary.—The members lost to the Society by death, are Dr. Spilsbury, Vice-President, and Dr. Walker, Sir Henry Lawrence, K. C. B., Sir Robert Barlow, Bart., Hon'ble J. R. Colvin, Captain F. Hayes, Hon'ble Major R. B. P. Byng, and Messrs. Bushby, Heatly, Ommanney, Cunliffe and D. Grant, most of whom had, when resident in Calcutta, taken as members either of the Council, or the Committee of papers an active part in the management of the Society's affairs.

To the zealous and disinterested labours of Dr. Spilsbury, extending over a period of 20 years, the Society is indebted for some of the rarest specimens which adorn its Geological Museum, and many of the valuable contributions which enrich the pages of its Journal. The Society has, more than once, publicly recorded its

high sense of the important services rendered to it by this zealous and distinguished member, and recently testified its gratitude by subscribing for the portrait which now graces its Meeting room.

Dr. Walker, whose zealous and disinterested devotion to science is well known, was a sincere and cordial friend to, and promoter of the objects of the Society.

Captain Hayes was a well known Persian and Arabic Scholar, and for some time acted as Secretary to the Society. His services in that capacity were acknowledged by a vote of thanks passed in May 1851.

Such losses as the above, and as that of Sir Henry Lawrence and Hon'ble Mr. John Colvin, who also took au earnest iuterest iu the Society's welfare, are not to be immediately or easily repaired.

By the death of the Baron Von Hammer Purgstall the cause of Oriental Literature has lost one of its brightest ornaments, and most ardent advocates, and the Society its oldest and not least distinguished honorary member. He devoted a long life of 82 years to the study of the Arabic, Persian and Turkish languages, and the success with which he prosecuted his researches is attested by the numerous works which he has left behiud him. The Society is especially indebted to him for a valuable paper on the navigation of the Arabs, published in the Journal.

Finances.—The steady improvement which the finances of the Society were gradually making, has received a severe check by the recent disturbances. The collections during the last year have been less than what was anticipated, while the statement of outstanding assets continues to be nearly the same as at the close of 1856.

The total receipts during the last year as shewn in the statement No. 1, have been Rs. 19,828-12-3, exclusive of the subscriptions (Rs. 2,676) for the purchase of the Stacey Coin collection, which have been deposited on a separate account in the Bank of Bengal.

The receipts include an item of Rs. 765-5-4, being a part of the loan recovered from the Oriental Publication Fund.

The disbursements amouut to Rs. 24,001-2-1, inclusive of a sum of Rs. 4,000, which have been invested in Government Securities. The cash balance in hand is Rs. 2,330-9-3, which added to the remaining loau Rs. 1,734-10-8, due from the Oriental Publication

Fund, will amount to Rs. 4,065-3-11, a sum adequate to meet any contingent expences that may be necessary for the purpose of a thorough repair to the building.

The total of the outstanding sums due to the Society is Rs. 8,463-2-6. The amount written off to profit and loss since the last report is Rs. 1,810-5-3, being mostly subscriptions due from deceased members. The Council apprehend that several items of a similar nature will have to be removed in the same way.

The estimate of the probable income and expenditure of the current year is given below. The expenses of the Zoological Museum have increased by Rs. 45 per month.

Income.

Contributions,		Rs. 7,850	0	0
Government Grant at 300,		3,600	0	0
Sale of Books,		1,200	0	0
Journals,		1,000	0	0
Interest,		225	0	0
Miscellaneous,		25	0	0
		13,900	0	0
Monthly average,		1,151	5	4

Expenditure.

Zoological Museum,				4,740	0	0
New cases, 7, about,				900	0	0
Library.						
Establishment,	936	0	0			
Purchase of Books,	600	0	0			
Book-binding,	350	0	0			
Contingencies,	200	0	0			
				2,086	0	0
Establishment, General				1,865	0	0
Journal,				2,896	0	0
Miscellaneous, including building repairs,				3,500	0	0
Deposit,				149	0	0
				16,136	0	0
Monthly average,				1,344	8	0

Reduction of Subscription of Mofussil Members.—In December 1856, Mr. Oldham made a proposition, to the effect that Rule 8 of the Society's Code should be modified so far as related to the subscriptions of non-resident members. That Ordinary Members should be divided into two classes, "Resident and Non-Resident," and that the latter, *i. e.*, the members who reside permanently at a greater distance than 12 miles from Calcutta or who may only occasionally visit it for periods shorter than three months, should pay the same admission fee, but a reduced subscription of 32 Rs. per annum.

The Council to whom the question was referred under Rule 45, reported, after mature consideration, that the financial position of the Society was not such as to permit them to recommend the proposed change, and, on its being referred to the Society at large, very few of the Non-resident Members voted in its favor. The motion was finally dropped at the Special Meeting held in July last, in consequence of a sufficient number of members not being present to constitute a Special Meeting as provided in Rule 45.

Library.—The Library has received an addition of 150 volumes, among which are some important MS. works, purchased at the sale of the late Aga Kurbalai Mahomed's Library. Several Sanscrit MSS. have been re-copied, and supplies of the leading Scientific periodicals have been regularly received. All the valuable books are now preserved in glazed cases, and every care is taken to keep them in proper order.

The Librarian has prepared a Supplement to the printed Catalogue, which includes all the works received from the time the Catalogue was sent to the press to the last day of December. This supplement will be available to members as soon as it is printed.

Coin Cabinet, Stacy's Collection.—In November 1856, the magnificent collection of gems and coins belonging to the late Colonel Stacy was offered to the Society for sale at 5,000 Rs. a sum which was subsequently reduced to 4,000 Rs. The Council anxious to secure to the Society this valuable collection, opened a subscription among the members, with a view to raise such a sum as would defray the whole or a large part of the amount necessary for the purpose. In a short time the sum of Rs. 2938 was subscribed, of

which Rs. 2,726 have already been realized. The Society has sanctioned an expenditure of Rs. 1,200, towards the purchase, which has been delayed only in consequence of the disturbed state of the country.

Some improvement has been effected in the arrangement of the Society's Coin Cabinet by Mr. Freeling; and it is hoped that on the receipt of the Stacy collection, the whole Cabinet will be systematically arranged, and rendered easily accessible to the public.

Museum of Economic Geology.—On the removal of the Government Museum of Economic Geology from the custody of the Society in 1856, the Government of India invited the Society to permit their own collections to be also transferred to the charge of the Superintendent of the Geological Survey in India, under such restrictions as the Society might chose to impose. The Council was divided in opinion on this question, and the proposition having been referred to the Society at large, was negatived at the last annual meeting.

Museum.—The Museum continues to be an object of interest and attraction to the public. That it is generally appreciated is shown by the figures quoted in the margin. During the year under review there were 43,928 Visitors, which, exclusive of Sundays and other Christian holidays, give an average of 142 persons per diem.

From Jan. to Dec. 1857 being 309 days open, exclusive of Sundays and other Christian holidays.

Native Males.	Females.	European Males.	Females.
38,430	2,090	2,597	811
		Total	43,928

Several glazed cases have been provided for the preservation and display of Zoological specimens, and the hands of the Curator in that Department have been strengthened by an increase of his establishment.

Dr. Falconer's important Catalogue of Tertiary fossils in the Society's collections, is in the Press, and will shortly appear.

Proposed Imperial Museum.—A careful inquiry into the condition of the Museum, its growing importance, and the scanty accommodation available in the Society's building, together with the inadequacy of the funds at their disposal, impressed the Council with the necessity of appealing to Government for aid. After mature deliberations they resolved that the most satisfactory mode of dealing with this important question would be to petition the Government

to institute a great Imperial Museum in Calcutta, to which the whole of the Society's collections might be transferred under certain restrictions. The Society approved the suggestion, and authorized the Council to open negotiations with the Government on the subject. But before any communication could be made the disturbances broke out in the North-Western Provinces, and the subject has since remained in abeyance.

A Committee of Meteorology and Physical Science has been reconstituted, consisting of the following Members:—

The Venerable J. H. Pratt.
Major H. L. Thuillier.
Dr. G. von Liebig.
Lt.-Colonel R. Strachey.
H. Piddington, Esq.
Baboo Radha Nauth Sikdar.

Journal.—The necessity of the times and the absorbing interest excited by the revolt, have operated prejudicially on the publication of the Journal. Comparatively few papers having been received, only 4 Nos. have been issued; the fifth is now in the press.

Officers.—The Librarian and Assistant Secretary, Baboo Gourdas Bysack has been assiduous in carrying on the duties of his office, and the Council have great pleasure in recording their entire satisfaction with the way in which he has performed them.

Oriental Fund.—The reasons which led to the suspension of the publication of the Bibliotheca Indica, were explained in the last annual report. The Council are glad to state that a considerable reduction in the liabilities of the Oriental Fund has been effected during the year, and they hope that before long the Fund will be in a position to enable the Editors to complete the unfinished works, and to commence a new Series under better auspices.

With the exception of the supplement to the Itqan, and the concluding Fasciculus of the S'ankhya Pravachana Bháshya (No. 141), no portion of the Bibliotheca Indica has appeared during the past year.

The report was adopted.

The Meeting then proceeded to ballot for the Council and officers for the ensuing year.

Major Thuillier and Dr. Eatwell were appointed scrutineers, and at the close of the ballot, the Chairman announced the following result:

Hon'ble Sir J. W. Colvile, Kt., *President.*

Bábu Rámgopal Ghose,
A. Grote, Esq.
Lieut.-Col. R. Strachey, } *Vice Presidents.*

T. Oldham, Esq.,
C. Beadon, Esq.,
Dr. T. Thomson,
Dr. T. Boycott,
Captain C. B. Young,
E. A. Samuells, Esq.,
Captain Dickens,
Captain Lees,
Bábu Ramáprasád Roy,

W. S. Atkinson, Esq.,
E. B. Cowell, Esq., } *Joint Secretaries.*

STATEMENT

Abstract of the Cash Accounts

RECEIPTS.

	1856.			1857.		
CONTRIBUTIONS.						
Received from Members, ..	8,096 0 0			7,068 0 0		
ADMISSION FEE.						
Received from new Members, ..	448 0 0			256 0 0		
JOURNAL.						
Sale proceeds of, and Subscription to the Journal of the Asiatic Society, ...	768 10 0	1,822 14 0				
Ditto received from the Bank of Bengal on old account, ..		108 12 5		1,931 10 5		
LIBRARY.						
Sale proceeds of Books, ..	1,662 1 9			1,225 4 0		
MUSEUM OF ZOOLOGY.						
Received from the General Treasury, at 300 Rs. per month, ..	3,600 0 0			3,600 0 0		
SECRETARY'S OFFICE, ..	5 3 3					
Discount on Postage Stamps, ...		1 11 6				
Refund of Postage, ...		7 10 0		9 5 6		
VESTED FUND, ...	125 12 1					
Interest on Company's Paper from the Bank of Bengal,..		130 0 0				
Discount on ditto, ...		10 0 0				
Interest on 2,500 Rs. advanced to the O. P. Fund, from Jan. to 31st Dec. 1857, at 4 per cent., ...		100 0 0		240 0 0		
GENERAL ESTABLISHMENT.						
Savings,..	2 2 0			74 9 9		
DEPOSIT ACCOUNT, ..	216 11 0					
Hon'ble R. B. Byng, ...		64 0 0				
Lt. H. Raverty, ...		90 0 0				
F. E. Hall, Esq.		43 5 0				
Lt. Terrot, ...		11 0 0				
Rev. Isidor Lowenthall, ...		13 0 0		221 5 0		
Carried over, ..				14,626 2		

No. 1.

of the Asiatic Society for 1857.

DISBURSEMENTS.

	1856.				1857.
CONTRIBUTIONS.					
Refund of contributions to A. Christison, Esq. ..					32 0 0
JOURNAL.	2,912 12 8				
Freight,..			75 1 0		
Printing Charges, ...			2,086 8 0		
Lithographing, ...			259 0 0		
Commission on Sale of Books, ..			13 1 3		
Purchase of Postage Stamps, ..			5 0 0		
Petty Charges, ...			11 7 6		
					2,450 1 9
LIBRARY, ...	2,216 15 11				
Salary of the Librarian, 12 months, at 70 per month, ..			840 0 0		
Establishment ditto, at 8 per month,			96 0 0		
Purchase of Books, per Messrs. Williams and Norgate, ..	Rs. 4392 8 0		4,569 5 9		
Ditto ditto, Calcutta, ..	176 13 9				
Printing 200 Catalogues of Books and Maps in the Library, ..			680 12 0		
Book Binding, ...			470 12 0		
Stationery, ...			1 14 0		
Postage, ...			23 11 0		
Purchase of Silver Coins,			4 0 0		
Commission on sale of Books,			58 7 0		
Printing receipts and circulars,			20 0 0		
Cleaning Charges, ...			6 12 0		
Petty Charges, ...			32 14 9		
					6,804 8 6
MUSEUM OF ZOOLOGY, ..	4,133 13 0				
Salary of the Curator at 250 per month, 12 months, ..			3,000 0 0		
House rent at 40 per month, 12 months, ...			480 0 0		
Establishment, ...			815 15 3		
Contingent charges, ..			149 15 6		
Extra Taxidermist's Salary, ..			45 10 9		
Printing 250 Copies of bills for Government Allowance, ..			5 0 0		
					4,496 9 6
SECRETARY'S OFFICE, ..	1,720 15 10				
General Establishment, ..			782 0 0		
Secretary's Office Establishment,			670 0 0		
Copying Charges, ...			6 0 0		
Carried over,			1458 0 0		13,783 3 9

RECEIPTS.

Brought forward, ..				14,626	2	8
Stacy Coin Collection,						
Received subcriptions for the purchase of the Collection, ...				2,676	0	0
Messrs. Williams and Norgate,						
Received from Rajah Radhacant Deva, ...	2	0	3			
„ sale proceeds of a copy of Bopp's Comparative Grammar, ...	25	0	0			
„ for suudry Books purchased, ...	4,392	8	0			
				4,419	8	3
Building.						
Received from the Municipal Commissioner's office, remission of the Lighting charges for the 1st and 2nd quarters of 1857, ...				15	0	0
Oriental Publication Fund.						
Received by transfer from Messrs. Williams and Norgate's account, Sale proceeds of Bib. Indica, ...				765	5	4
G. H. Plowden, Esq.						
Refund of Postage, ...				0	4	0
Dadoba Pundurang, Esq.						
Received on account current of Freight, ...				2	8	0
Balance of 1856.						
Bank of Bengal, ...	6,574	14	10			
Cash in hand, ...	89	15	3			
				6,664	14	1
Inefficient Balance, ...				470	0	3
Carried over,				29,639	10	7

DISBURSEMENTS.

Brought forward,	1458	0	0	13,783	3	9
Postage, ...	20	3	3			
Stationery, ...	77	5	6			
Purchase of Postage Stamps, ..	58	8	0			
Printing Charges, ...	69	9	3			
Engraving a plate for contribution bills, ...	10	0	0			
Petty Charges, ...	45	6	9			
				1,739	0	9
Vested Fund.						
Purchase of Government Securities, ...	0	0	0	4,000	0	0
Commission paid to the Bank of Bengal for investing in Company's Paper 4,000 Rs. @ 4 per Cent., ...	0	0	0	10	0	0
Paid Commission for the Collection of interest on Company's Paper, ...	0	5	3			
Do. Interest on Company's Paper,	2	3	6			
Ditto for renewing company's papers, ...	9	0	0			
				11	8	9
Deposit Account,						
F. E. Hall, Esq., ...	75	7	0			
Hon'ble Sir J. W. Colvile, Kt.,..	12	0	0			
W. Theobald, Esq.	10	8	0			
Hon'ble R. B. Byng, ..	48	0	0			
W. S. Blanford, Esq. ..	10	0	0			
				155	15	0
Stacy Coin Collection.						
Paid to the Secretary by a cheque to be kept on a separate acct.				2,726	0	0
Messrs. Williams and Norgate,						
Paid H. Piddington, Esq. as per their order, ...	780	0	0			
Purchase of Books on their Account, ...	77	0	0			
Freight on Do. Do. ..	11	4	0			
Amount paid for purchase of books from 1853 to 1857 by transfer of the sale proceeds of the Society's publications in their hands, ..	2,102	7	4			
				2,970	11	4
Building,						
Assessment, ...	280	0	0			
Ditto for Lighting Gas, ..	63	0	0			
Sundry Repairs, ...	56	11	6			
Paving the floor with Stones, ..	495	7	0			
				895	2	6
				26,291	10	1

RECEIPTS.

Brought forward,	29,639	10	7
	29,639	10	7

MEMO. OF DEPOSITS.

Balance at the close of 1856,	362	13	0
Amount credited in 1857,	221	5	0
	584	2	0
Deduct debited in ditto,	155	15	0
Balance at the close of 1857,	428	3	0

The Asiatic Society's Room,
The 31st December, 1857.

E. E.
GOURDAS BYSACK,
Asst. Secy.

DISBURSEMENTS.

Brought forward,						26,291	10	1
G. H. Plowden, Esq.								
Postage stamps paid on his account, ...						0	4	0
Dadova Pandurang, Esq.								
Postage stamps paid on his account, ...						2	5	0
Miscellaneous, ..	233	0	0					
Advertising Meetings, ..				49	3	0		
Meeting Charges, ...				146	8	0		
Printing balloting papers, &c. ..				20	0	0		
New Mats for the Rooms, ..				88	3	0		
Repairing a Clock, ..				8	0	0		
Gardener's wages, ...				14	12	9		
Petty Charges, ...				106	4	3		
							432	15	0
Balance.								
Bank of Bengal, ...				2,321	11	3		
Cash in hand, ...				8	14	0		
							2,330	9	3
Inefficient Balance, ...							581	15	3
							29,639	10	7

W. S. Atkinson,

Secretary.

STATEMENT

Abstract of the Oriental

RECEIPTS.

	1856.						1857.		
Balance of 1856, Bank of Bengal,	283	13	6						
Cash in hand, ...	1	14	0						
				285	11	6			
Inefficient Balance, ...				2,092	14	8			
							2,378	10	2
Sale of Oriental Publications, ...	1,323	12	11						
Received by sale of Bib. Indica, ..				1,066	1	4			
Ditto by subscription to Do., ..				91	10	0			
							1,157	11	4
Government Allowance, ..	6,000	0	0						
Received from General Treasury at 500 per month, ...							6,000	0	0
Vested Fund, ...	209	7	6						
Interest on Company's Paper from Government Agent, ..				140	0	0			
Ditto on Ditto from Bank of Bengal, ...				70	0	0			
							210	0	0
Custody of Oriental Works Fine,							2	0	0
Carried over,							9,748	5	6

No. 2.

Fund for the year 1857.

DISBURSEMENTS.

	1856.						1857.		
SALE OF ORIENTAL PUBLICATIONS,	79	11	9						
Freight, ...				18	0	0			
Commission, ...				35	13	6			
							53	13	6
PURCHASE OF BOOKS & MSS.									
From Messrs. Mackenzie, Lyall and Co. and others, ..							334	6	0
VESTED FUND.									
Commission paid to the Bank of Bengal for collecting Interest on Company's Paper, ..				0	8	6			
Interest paid to the Asiatic Society on the Loan of Rs. 2,500,				100	0	0			
							100	8	6
CUSTODY OF ORIENTAL WORKS,	705	1	6						
Salary of Librarian at 30 per month, 12 ms., ...				360	0	0			
Establishment at 12 per month ditto,..				144	0	0			
Book binding, ...				129	0	0			
Books cleaning, ...				20	0	0			
Copying Charges, ...				4	0	0			
Extra Duftry, ...				12	8	0			
Petty Charges, ...				2	8	0			
Printing Charges, ...				5	0	0			
Commission on Purchase of Books,				5	0	0			
Stationery, ...				1	0	0			
							683	0	0
ASIATIC SOCIETY.									
Amount due to the O. P. Fund on account of the sale of Bib. Indica as per Accounts Current of Messrs. Williams & Norgate, £76-10-8, ...							765	5	4
COPYING OF MSS., ..	78	9	3						
Copying charges, ...							80	3	9
VASAVADATTA, ..	228	6	0						
Printing Charges, ...							224	0	0
UPANISHADS.									
Printing Charges, ...							448	0	0
MARKANDEYA PURANA, ..	465	0	0						
Printing Charges, ...				232	8	0			
Editing Charges, ...				60	0	0			
							292	8	0
				Carried over,			2,981	13	1

Brought forward,	9,748	5	6
	9,748	5	6

E. E.
GOURDAS BYSACK,
Asst. Secy.

The Asiatic Society's Rooms,
The 31*st Dec.* 1857.

				Brought forward,			2,981	13	1
TADZ KERAL.									
Printing Charges, ...							96	0	0
SANHITA OF THE BLACK YAJUR VEDA.									
Printing Charges, ...							904	0	0
WAQIDY, ...	675	8	0						
Printing Charges, ...							232	12	0
BRIHAD ARANYA UPANISHADS,	160	0	0						
Printing Charges, ...							332	0	0
BALANCE.									
Bank of Bengal, ...	3,059	9	0						
Cash in hand, ...	29	4	9						
				3,088	13	9			
Inefficient Balance, ...				2,112	14	8			
							5,201	12	5
							9,748	5	6

W. S. ATKINSON,

Secretary.

STATEMENT No. 3.

Assets.

CASH.	1856.			1857.		
Bank of Bengal, ...Rs.	6,574	14	10	2,311	11	3
Cash in hand, ...	89	15	3	8	14	0
Inefficient Balance, ...	470	0	3	581	15	3
Company's Paper, ...	500	0	0	4,500	0	0
Loan to the Oriental Publication Fund, ...	2,500	0	0	1,734	10	8
	10,134	14	4	9,137	3	2
OUTSTANDING.						
Contributions,.....	7,205	11	8	7,146	2	6
Admission Fee, ...	96	0	0	96	0	0
Library, Sale of Books,.....	329	4	0	289	0	0
Journal, Subscription to, ...	1,185	12	0	866	8	0
Ditto, Sale of, ...	9	8	0	65	8	0
	8,826	3	8	8,463	2	6

Liabilities.

DEPOSITS.	1856.			1857.		
Hon'ble Sir J. W. Colvile, Kt., ...	291	8	0	279	8	0
Other Deposits, ...	0	0	0	148	11	0
DEBTS.						
J. W. Laidlay, Esq.....	418	7	4	418	7	4
Journal Nos. IV. and V. of 1857, say,.....	0	0	0	497	0	0
Miscellaneous Printing, about, ...	135	0	0	250	0	0
Messrs. Williams and Norgate, ...	0	0	0	990	0	11
New Glazed cases for the Bird Room, ...	0	0	0	659	8	0
				3,243	3	3

The Asiatic Society's Rooms,
—The 31st December, 1857.

E. E.
GOURDAS BYSACK,
Asst. Secy.

W. S. ATKINSON,
Secretary, Asiatic Society.

LIST OF ORDINARY MEMBERS

OF THE

ASIATIC SOCIETY OF BENGAL,

ON THE 31ST DECEMBER, 1857.

The * distinguishes non-subscribing Members.

Abbott, Lieut.-Col. J. Bengal Artillery, Ishapur.
*Allen, C. Esq. B. C. S., Europe.
*Anderson, Lieut.-Col. W. Bengal Artillery, England.
Atkinson, W. S. Esquire, Calcutta.
Avdall, J. Esquire, Calcutta.
*Baker, Lt.-Col. W. E. Bengal Engineers, Europe.
Batten, J. H. Esquire, B. C. S., North West Provinces.
Beadon, C. Esquire, B. C. S., Calcutta.
Beaufort, F. L. Esquire, B. C. S., Calcutta.
Beckwith, J. Esquire, Calcutta.
*Benson, Lt.-Col. R., Eugland.
Birch, Col. R. J. H. C. B., Calcutta.
Bivar, Capt. H. S. 18th Regt. B. N. I., Northern Cachar.
Blagrave, Capt. T. C. 26th Regt. B. N. I. Trans-Sutledge Provinces.
Blanford, H. F. Esq. Government Geological Survey.
Blundell, E. A. Esquire, Singapore.
*Bogle, Lt.-Col. Sir A. Kt., England.
Boycott, Dr. T. Bombay M. S., Calcutta.
*Brodie, Capt. T. 5th Regt. B. N. I., Europe.
Burgess, Lt. F. J. 17th Regt. B. N. I., Nowgong.
Busheerooddeen Sultan Mahamed, Saheb, Calcutta.
Campbell, Dr. A. B. M. S., Darjiling.

Chapman, C. Esq. B. C. S., Bhagulpore.
Chapman, R. B. Esq., B. C. S., Calcutta.
Colvile, Hon'ble Sir J. W. Kt., Calcutta.
Colvin, B. J. Esquire, B. C. S., Calcutta.
*Colvin, J. H. B. Esq., B. C. S., Europe.
Cowell, E. B. Esq., Calcutta.
Crozier, W. Dr., B. M. S., Calcutta.
*Cust, R. N. Esq., B. C. S., Europe.
Dalton, Capt. E. S. 9th Regt. B. N. I., Chota Nagpur.
*De Bourbel, Lt. R. Bengal Engrs., Europe.
Dickens, Capt. C. H., Calcutta.
Drummond, Hon'ble E., B. C. S., Calcutta.
Eatwell, Dr. W. C. B., Calcutta.
*Edgworth, M. P. Esq. B. C. S., Europe.
Elliott, Hon'ble W., M. C. S.
Ellis, Major R. R. 23rd Regt. B. N. I., Bundlekund.
Elphinstone, Lieut. N. W. 4th Regt. B. N. I., Goorgariah.
Erskine, Major W. C. Commr. of Saugur, Nurbudda Territories, Jubulpur.
*Falconer, Dr. H., F. R. S., B. M. S., Europe.
Fayrer, Dr. J., B. M. S.
*Freeling, G. H. Esq., B. C. S., Europe. Since returned.
Fytche, Major A. 70th Regt. B. N. I., Bassein.
*Gladstone, W. Esq., Europe.
Govinchunder Sen, Bábu, Calcutta.
Grapel, W. Esq., Calcutta.
Gray, J. J. Esq., Maldah.
Grote, A. Esquire, B. C. S., Calcutta.
*Gubbins, C. Esq., B. C. S., Europe.
Hall, F. E. Esq. M. A., Saugur.
Halsey, W. S. Esq., B. C. S., Gurruckpore.
*Hamilton, R. Esq., China.
Hamilton, Sir R. N. E. Bart., B. C. S., Indore.
Hannyngton, Lieut.-Col. J. C. 24th Regt. B. N. I., Berhampore.
Hearsay, Major Genl. J. B., K. C. B. 10th Light Cavalry, Barrackpore.
Herschel, W. J. Esq. B. C. S., Jungipore.

*Hichens, Lieut. W. Bengal Engineers, Europe.
Hodgson, B. H. Esq. B. C. S., Darjiling. Since gone to Europe.
Hossein Ally Mohamed, His Highness Ex-Ameer of Scinde, Calcutta.
Ishureepershad, Rajah, Benares.
*Jackson, L. S. Esq., Europe.
*Jackson, W. B. Esq. B. C. S., Europe.
Jadava Krishna Sinhâ, Bábu, Calcutta.
James, Capt. H. C. 32nd Regt. B. N. I., Darjiling.
Jenkins, Lieut.-Col. F., Assam.
Jerdon, T. C. Esq. M. M. S.
*Johnstone, J. Esq., Europe.
Joygopaul Bysack, Bábu, Calcutta.
Kabeeroodeen Ahmed Shah, Bahadoor, Sassaram.
Kay, Rev. W., D.D., Bishop's College.
*Laidlay, J. W. Esq., Europe.
Layard, Capt. F. P. 19th Regt. B. N. I., Berhampore.
Lees, Captain, W. N., 42nd Regt. B. N. I., Calcutta.
Liebig, Dr. G. Von, B. M. S., Calcutta.
Loch, G. Esq. B. C. S., Calcutta.
*Loch, T. C. Esq. B. C. S., Europe.
Loftie, Lieut.-Col. M. E.
Low, Major Genl. Hon'ble J., Calcutta.
*Lushington, F. A. Esq. B. C. S., Europe.
Maclagan, Capt. R., N. W. Provinces.
Macleod, D. F. Esq. B. C. S., Lahore.
Macrae, Dr. A. C., B. M. S., Calcutta.
Manickjee Rustomjee, Esq., Calcutta.
*Marshman, J. C. Esq., Europe.
*Middleton, J. Esq., Europe.
Medlicott, J. G. Esq., Calcutta.
*Mills, A. J. M. Esq. B. C. S., Europe.
Money, D. J. Esq. B. C. S., Calcutta.
Money, J. W. B. Esq. B. C. S., Calcutta.
Morris, G. G. Esq. B. C. S., Rungpur.
Morton, D. T. Esq., M. D., Moulmein.
*Muir, J. Esq., Europe.
Muir, W. Esq. B. C. S., Allahabad.

*Nicholls, Capt. W. T. 24th Regt. M. N. I., Europe.
Nogendranáth Tagore, Bábu, Calcutta.
Oldham, Prof. T., F. R. S., Calcutta.
O'Shaughnessy, Sir. W. B., Bombay.
*Ouseley, Major W. R., Europe.
*Phayre, Major A., Europe. Since returned.
Prasunnonáth Roy, Rajá, Bahadur, Degaputti, Rajshaye.
Pratt, the Venerable Archdeacon, J. H., Calcutta.
Pratápchandra Siñha, Rájá, Calcutta.
*Prinsep, C. R. Esq., Europe.
Prasaunacumár Tagore, Bábu, Calcutta.
Rádhánáth Sikdar, Bábu, Calcutta.
Rajendrá Dutt, Bábu, Calcutta.
Rajendralâl Mittra, Bábu, Calcutta.
Rámánáth Bánnorjee, Bábu, Calcutta.
Ramánáth Tagore, Bábu, Calcutta.
Ramáprasad Roy, Bábu, Calcutta.
Rámchandra Siñha, Rájá, Calcutta.
Rámgopál Ghose, Bábu, Calcutta.
Riddell, H. P. Esq. B. C. S., Calcutta. Since gone to Europe.
Roberts, A. Esq. B. C. S., Jubbulpore.
Röer, Dr. E., Cuttack.
Rogers, Capt. T. E., Calcutta.
Row, Dr. J. B. M. S., Calcutta.
*Royle, Dr. J., F. R. S., Europe. Since dead.
*Russell, R. H. Esq., Europe.
Samuells, E. A. Esq., B. C. S., Patna.
Saxton, Capt. G. H. 38th M. N. I., Cuttack.
*Schiller, F. Esq., Europe.
Seton-Karr, W. Esq., Tirhoot.
Sherwill, Capt. W. S. 66th Regt. B. N. I. Dum-Dum.
*Smith, Col. J. T., Europe.
Smith, Rev. W. O., Calcutta.
Spaukie, R. Esq. B. C. S. Saharunpore.
*Sprenger, Dr. A., Europe.
Stephen, Major J. G. 8th N. I., Raneegunge.
Strachey, Lt.-Col. R., Bengal Engineers, Calcutta.

*Strachey, J. E. Esq. B. C. S., Europe.
*Strong, F. P. Esq. B. M. S., Europe.
Satyasharana Ghosal, Rájá, Calcutta.
*Thomas, E. Esq., B. C. S., Europe.
Thomson, Dr. T., M. D., F. R. S., Botanical Gardens.
Thornhill, C. B. Esq. B. C. S., Nynee Tal.
Thuillier, Major H. L., Artillery, Calcutta.
Thurnburn, Capt. F. A. V. 14th Regt. B. N. I., Oude.
Trevor, C. B. Esq. B. C. S., Calcutta.
Ward, J. J. Esq. B. C. S., Cuttack.
Watson, J. Esq., B. C. S., Berhampur.
Waugh, Col. A. S., Bengal Engrs., Derra Dhoon.
Wilson, The Right Rev. D., Lord Bishop, Calcutta. Since dead.
Woodrow, H. Esq., Calcutta.
Young, Capt. C. B. Bengal Engrs., Calcutta.
Yule, Major H. Bengal Engrs. Calcutta.

Elected in 1857.

H. F. Blanford, Esq., Calcutta.
E. B. Cowell, Esq., Calcutta.
Joygopaul Bysack, Bábu, Calcutta.
Dr. W. C. B. Eatwell, Calcutta.
Rájá Prasunonauth Râyâ, Bahádur, Degaputti, Rajshayee.
Dr. W. Crozier, B. M. S., Calcutta.

Loss of Members during the Year 1857.

Withdrawn.

Dr. A. Christison, Gwalior.
Lieut. R. Stewart, Cachar.
Dr. W. Martin, Calcutta.
Rev. K. M. Banerjee, Calcutta.
J. W. Sherer, Esq., Allighur.
P. W. LeGeyt, Esq., Calcutta.
J. Willis, Esq., Calcutta.
D. G. Nicholson, Esq., Moulmein.
J. F. Curtis, Esq., Calcutta.
A. R. Young, Esq., Calcutta.

W. G. Young, Esq., Calcutta.
Dr. F. J. Mouat, Calcutta.
Lieut. H. S. Forbes, Artillery, Benares.
Major J. C. Haughton, Moulmein.

By Death.

G. A. Bushby, Esq., Gwalior.
S. G. T. Heatley, Esq., Delhi.
M. C. Ommanney, Esq., B. C. B., Lucknow.
D. Grant, Esq. B. C. S., Futteghur.
Capt. F. C. C. Hayes, 66th Regt. B. N. I., Lucknow.
Dr. G. G. Spilsbury, Calcutta.
Dr. H. Walker, Europe.
Col. Sir H. Lawrence, Oude.
Barlow, Sir R., Bart, B. C. S., Europe.
Hon'ble J. R. Colvin, Agra.
Captain R. B. P. Byng, 62nd Regt. B. N. I.,
C. W. Cunliffe, B. C. S. Lucknow.

Honorary Member.

Baron Von Hammer-Purgstall, Aulic Counsellor, Vienna.

List of Honorary Members.

M. Garcin de Tassy, Membre de l' Instit, Paris.
Sir John Phillippart, London.
Count De Noe, Paris.
Prof. Francis Bopp, Memb. de l' Academie de Berlin.
Sir J. F. W. Herschel, F. R. S. London.
Col. W. H. Sykes, F. R. S. Do.
General Count Ventura, Europe.
Prof. Lea, Philladelphia.
Prof. H. H. Wilson, F. R. S., London.
Prof. C. Lassen, Bonn.
Sir G. T. Staunton, Bart., F. R. S., London.
M. Reinaud, Memb. de l' Instit, Prof. de l' Arabe, Paris.
Dr. Ewald, Gottingen.
His Highness Hekekyan Bey, Egypt.

Right Hon'ble Sir Edward Ryan, Kt., London.
Prof. Jules Mohl, Memb. de l' Instit, Paris.
Col. W. Munro, 39 Regt.
His Highness the Nawab Nazim of Bengal, Murshedabad.
Dr. J. D. Hooker, R. N., F. R. S. London.
Prof. Henry, Princeton, United States.
Lt.-Col. Sir H. C. Rawlinson, K. C. B., London.
Lt.-Col. Sir Proby T. Cautley, K. C. B., London.
Rájá Rádhákánta Devá Bahádur, Calcutta.

Corresponding Members.

Kremer, Mons. A. Von, Alexandria.
Porter, Rev. J., Damascus.
Schlagintweit, Mons. H.
Schlagintweit, Mons. A.
Smith, Dr. E., Beyront.
Tailor, J. Esq. Bussorah.
Wilson, Dr., Bombay.
Nietner, J. Esq., Colombo, Ceylon.

Associate Members.

Blyth, E. Esq., Calcutta.
Káramt, Ali Syud, Matawalli, Hooghly.
Long, Rev. J., Calcutta.
MacGowan, Rev. J., Ningpo.
Piddington, H., Esq., Calcutta.
Stephenson, J. Esq. Europe.

For February, 1858.

At a monthly General Meeting of the Asiatic Society held on the 3rd instant.

Major H. L. Thuillier, Senior Member present, in the chair.

The proceedings of the December meeting were read and confirmed.

Presentations were received—

1.—From the Government of Madras, copies of Selections from the records of the Government.

The Secretary stated that these publications had been sent, in compliance with a request made by the Council, who were glad to announce that the Government of Madras have ordered that the Society should be supplied with all the Selections that may hereafter be published.

2. From Mr. C. Joseph, a copy of his new map of the country, from Calcutta to Lahore, shewing the course of the rail, and the Grand Trunk Road.

3. From the Principal of the Grant Medical College Bombay a copy of the Report of the Grant Medical College, for the Session 1856-57.

4.—From the Secretary to the Government of the Central Provinces, a plan of the Village and Fort of Bilhere.

5.—From Captaiu Hill, Bankshall, through Mr. Piddington, a Dayak Coin from Tringam, Coast of Borneo.

Recorded a note from B. H. Hodgson, Esq., C. S. announcing his departure for England, and another from Mr. C. Gubbins, C. S. announcing that being about to retire from the Service, he wished his name to be removed from the list of paying members.

The Council submitted a report announcing, that they had appointed the following Sub-Committees.

Finance.

Dr. T. Boycott.
Captain C. H. Dickens.

PHILOLOGY.

A. Grote, Esq.
E. A. Samuells, Esq.
Rev. J. Long.
F. E. Hall, Esq.
E. B. Cowell, Esq.
Dr. E. Roër.
Captain W. N. Lees.
Baboo Rajendralal Mittra.

LIBRARY.

E. A. Samuells, Esq.
W. Grapel, Esq.
Baboo Ramapersad Roy.
Lieut.-Col. R. Strachey.
Baboo Rajendralal Mittra.
Captain W. N. Lees.
Captain C. H. Dickens.

NATURAL HISTORY.

E. A Samuells, Esq.
T. Oldham, Esq.
Dr. T. Thomas.
Dr. T. Boycott.
Captain C. B. Young.
Lieut.-Colonel R. Strachey.
H. F. Blanford, Esq.

METEOROLOGY AND PHYSICAL SCIENCE.

The Venerable J. H. Pratt.
Major H. L. Thuillier.
Dr. Von Liebig.
Lieut.-Colonel R. Strachey.
H. Piddington, Esq.
Baboo Rada Nauth Sikdar.

The election of Monsieur R. Schlagintweit as a corresponding member of the Society was deferred under rule 6 of the bye-laws.

Baboo Kaliprosono Sing, duly proposed and seconded, at the December meeting, was declared elected.

Communications were received.

1.—From Baboo Rada Nauth Sikdar, forwarding abstracts of the Meteorological Register kept at the office of the Surveyor General, Calcutta, for August and September last.

2.—From Dr. Campbell, Darjiling, through Major Thuillier, copy of a Register of the Temperature of the Ocean, with the chart of the voyage of the "Agamemnon" shewing the daily position of the ship at noon, from the Sandheads of the Hooghly, to the river Thames.

3.—From Mr. Oldham, a notice of the recent additions to our knowledge of the Cretaceous Rocks of India.

The paper was read by the Secretary and the thanks of the meeting were accorded to the Author.

Some Terracotta sculptured slabs which Captain Yule had received from Ava, were at his request exhibited to the meeting, and excited considerable interest.

The librarian submitted his monthly reports for December and January last.

The following is Mr. Oldham's paper.

On some additions to the knowledge of the Cretaceous rocks of India. By THOMAS OLDHAM, *LL. D., F. R. S., M. R. I. A., F. G. S. &c., Superintendent of the Geological Survey of India.*

At the meeting of the Society for the month of May 1857, Mr. Henry Blanford and myself were present, with the intention of laying before the Society, a brief notice of a very important discovery bearing on the Geology of India which had not long previously been made. This was the fact of the occurrence of rocks of the Cretaceous epoch in the western portion of the Nerbudda district. And the specimens illustrative of the intended communication were laid on the table. The attention of the meeting on that occasion, having been fully occupied by other matters of interest, and importance, which came before it, time did not allow of this geological communication being brought forward, and as both Mr. Blanford and myself shortly afterwards left Calcutta, the subject was not again brought before the Society. I am, however, desirous of recalling these facts, from the circumstance that the same discovery has subsequently been brought forward elsewhere,

and I desire to place on record the facts of the case, more fully than has hitherto been done, that the friend whose zeal first led to the discovery may be rewarded by obtaining full merit for his intelligent research.

All those who have given any attention to the study of Indian geology, are aware that previously to last year, rocks of the cretaceous epoch, were only known to occur, in the South of the Indian Peninsula, forming a band, the limits of which were supposed to be near Trichinopoly on the South, and near Pondicherry on the North. The true relations of this band of cretaceous rocks, have never been fully investigated, but a very beautifully preserved, and numerous suite of fossils had been collected from them by Messrs. Kay and Brooke Cunliffe, of the Madras Civil Service, which were presented to the Geological Society of London. The description of these fossils was undertaken by the late Professor Edward Forbes, and a most valuable and instructive memoir, fully illustrated with excellent plates, was published in the 3rd part of the 7th vol. of the Geological Transactions, London.

After giving a detailed description of the species found, Professor Forbes entered on a discussion of the inferences to be drawn from the Fauna thus represented. It must be borne in mind that previously to this publication, the occurrence of any rocks, representatives of the cretaceous epoch in India, had often been denied, and that there was no fixed geological horizon to which such a new discovery could be referred. The physical relations of the rocks containing the fossils to any other recognised groups were unknown, and it was only from a discussion of the organic remains contained in them, that any just inference as to their geological age could be attained.

Professor Forbes entered fully into this discussion, and from a careful analysis of all the evidence arrived at the conclusion, that all the beds from which fossils had been obtained were parts or members of one and the same series, and that that series was equivalent to the cretaceous series of Europe; the deposits at Trichinopoly and Verdachellum, being probably equivalent to the upper greensand and gault divisions of that series; the deposit near Pondicherry, being equivalent to the Neocomien, or lower greensand.

During a brief visit to Madras in the autumn of 1856, I was indebted to the kindness of Mr. Brooke Cunliffe, one of the original labourers at these deposits, for a valuable collection of these fossils chiefly from the Utatur locality. This collection at once proved the correctness of the closing words of Professor Forbes' valuable paper that "Verdachellum and Trichinopoly will doubtless yield many more species than have yet been brought to Europe," for in it were many beautiful and well marked forms previously undescribed. But it also showed conclusively, that a still further and more careful research was requisite, before it could be supposed that anything like fair data had been obtained, for arriving at trustworthy conclusions as to the true character of the Fauna of this period in Southern India. The relative abundance of species, and even of genera seemed in many respects very different from that which the original collection gave, and it appeared *probable* that much of this difference in different localities was the result of a difference in depth of the sea at the time of deposit, and not of difference in time—a result not in accordance with the conclusions arrived at by Professor Forbes.

Among the small collection presented by Brooke Cunliffe, Esq. not less than 93 species were distinguished. Of this large number only 33 were known to Professor Forbes from the original collection; leaving an addition to the Fauna known up to that time from these rocks of 60 species. Without exception these 60 species all tended to confirm the opinion of Forbes, that these rocks were of cretaceous age. A summary is given below of these additions generically, reserving the details of specific description until it is possible to prepare illustrations of the fossils. But a group or two may be referred to, in illustration of our remarks. Thus, taking the several well marked sections of the great genus *Ammonites*, among the large addition to the known catalogue of species, which Mr. Cunliffe's collection has given, we have none of the *Fimbriati*, an oolitic and cretaceous section; none of the *Flexuosi*, also a lower cretaceous section; none of the *Dentati*, also lower cretaceous; none of the *Armati*, an upper oolitic section; none of the *Lævigati;* while on the other hand of the *Cristati*, a section essentially cretaceous, we find one; of the *Clypeiformi*,

also a cretaceous section, one: of the *Heterophylli* five, and *all* of the cretaceous subdivision of this section; of the *Ligati*, a group essentially cretaceous, not less than ten.

Of *Nautilus*, a genus having a larger development in the upper, than in the lower beds of the cretaceous, we have three allied to other cretaceous forms; of *Belemnitella*, confined to the upper portion of the cretaceous group, one. And other instances might be given. These will however suffice to shew, that a vast addition to the cretaceous Fauna of India still remains to be worked out.

I would add that Mr. H. F. Blanford, with others, is at present engaged in making out the relation of these rocks, and I confidently anticipate, that much light will be thrown upon the subject, by tho careful examination of the Officers of the Geological Survey in that district.

Abstract of fossils from Utatur near Trichinopoly.

	Species previously known.	Species unknown.
Zoophyta.		
Turbinolia,		
Echinodermata		
Brissus,	3	2
Nucleolites,	0	1
Holaster,	0	1
Crustacea.		
Cancer (?)	0	1
Mollusca. (*Acephala.*)		
Inoceramus,	0	3
Pecten,	2	0
Ostrea,	0	4
Gryphœa,	2	1
Pinna,	0	2
Arca,	0	4
Pectunculus,	0	1
Modiola,	1	1
Trigonia,	1	1
Solecurtus,	0	1
Cardium,	0	2

	Species previously known.	Species unknown.
(Gasteropoda),		
Natica,	1	0
Trochus,	1	0
Pleurotomaria,	1	0
Voluta,	2	0
Phasianella,	0	1
Strombus,	1	0
Tornatella,	1	0
(Cephalopoda)		
Baculites,	2	0
Ptycoceras,	0	1
Hamites,	5	4
Turrilites,	1	1
Ammonites,		
Cristati,	0	1
Lævigati,	1	0
Clypeiformi,	0	1
Heterophylli,	1	5
Ligati,	3	10
Nautilus,	1	3
Belemnites,	0	2
Belemnitella,	0	1
Annelida.		
Serpula,	0	2
Pisces.		
Odontaspis,	1	0
Otodus,	2	0
Lamna,	0	1

The above list refers solely to the collection of fossils presented to the Geological Museum by Brooke Cunliffe, Esq.

Nerbudda District.—During the season of 1855-56, while engaged in the examination of the valley of the Nerbudda, I had the pleasure of meeting Captain R. H. Keatinge, Assistant Political Agent for Mewar, at Poonassa. Among other things our conversation turned upon the coralline limestone, of which the ancient town

of Mandoo had been built. I took the opportunity of pointing out the extreme interest attaching to this limestone in a geological point of view, and the utter ignorance under which we rested as to its age or relations. It had been very ingeniously, and correctly inferred by Dr. Carter, in his carefully compiled "Summary of the Geology of India," that this limestone used at Mandoo had been derived from near Baug or Bagh, which inference I pointed out to Captain Keatinge in Dr. Carter's paper, telling him at the same time my own impression that it would prove to be, not oolitic, as provisionally supposed by Dr. Carter, but of the nummulitic age. I strongly urged Captain Keatinge to visit the locality indicated, and to collect any fossils that might be found, feeling confident, that it would yield a rich harvest of many forms other than corals. I felt sure that it was only requisite to point out to this enlightened officer, the interest of the enquiry, to secure his zealous co-operation. Nor was I disappointed. In a letter dated Nov. 4th, 1856, after stating that he had been prevented from getting out much sooner, as he had intended, he says: "I started West, without, however, the least idea of where I was going to. I got out 20 miles to Kala Bowli all well. I mounted at ¼ to 1 P. M., to go to Cheera Khan, which name sounded well. It was distant 8, 10, 5, 14 coss, as you pleased. Early in the afternoon I got it down to 3 coss, but alas I rode until after dark, and it was still 3 coss, and is 3 coss now I believe, at least I never get any nearer. * * * I talked to the Bheels about black stone, until I succeeded in making them say that I should find white, which consoled me much. * * * * From the information I got I started the next morning in a S. W. direction for Deola, on the Maan river. After going a coss I saw the limestone in the bed of a nullah, and in a coss more I was in the midst of it. Where I was (near Deola) the limestone lay in a valley about a mile broad. N. and S. the country was all hilly, the top of the hills covered with trap; and the bed of the Maan trap. I could make nothing of the general geological arrangement. In the valley the limestone was horizontal, on the hill sides it always seemed to slope down hill, but it may have been merely that the slabs had fallen one over the other. But the fact is, I had only two days to work in, and occupied them in collecting fossils.

"Higher up at Surbaperce on the Maan, I thought I traced the following succession, (ascending) a light green stone metamorphic or volcanic; a soft sandstone, very fine grained and white; compact limestone, bluish white; and then the coral limestone, the latter only containing corals. The compact fine limestone, is found at intervals all over the jungle, and has been very largely used for lime in the Mandoo days; the old kilns are without number. Now as to the fossils, I found them wherever an edge of stone lay over a convenient mud bed to retain them; and oh! the spear grass!! &c. &c. The *Echinida (Micraster coranguinum*)* were in great plenty (the Bheels call them Paunchia from their five marks) and what I suppose to be *Pecten 5-costatus.*† *Plagiostoma spinosum* and *Terebratula octoplicata* were numerous, the latter the most numerous and in best preservation. There are a good many other things too you will find in the box I have to day posted for you. There are pieces of a large finely marked *Echinus (Cidaris)* and I have a half one of the same sort of which I send you a sketch. I have kept it to show the natives what I want on some future occasion. There is also a rude impression on a stone I have got, of a very large shell, say six inches long.‡

"I have kept half the fossils to shew Mr. Blackwell, but you will find some nice small ones wrapped separately in paper."

On receipt of these fossils, they were at once looked to, and it was found that although some of these specific distinctions were not correct, they entirely supported the conclusions of Captain Keatinge; and that here to the West of Mhow and Indore, in a country where such was before altogether unknown, there existed extensive beds of the cretaceous series. The importance of this fact, in its bearing on all reasonings as to the physical geography of the country at former periods, will be obvious to every one who has considered such questions, and its influence on the question of the still doubtful age of the rocks in the adjoining district was also great. Eagerly therefore I congratulated Captain Keatinge on his valuable discovery, and urged a further exploration of the field. And I had the pleasure of hearing the result in the beginning of the

* This is a *Brissus.* † It is so. ‡ *Inoceramus?*

year. (March 1857.) Captain Keatinge had, in company with Mr. Blackwell, Mineral viewer to the Bombay Government, revisited the Baug district in the month of January, and has favored me with an extract from his journal, which being brief, and full of interest, I give entire.

Extracts from Captain Keatinge's Journal.

14*th January*, 1857.—From Mundlaisir marched 15 miles to Khul, where the Bombay and Agra road crosses the Nerbudda.

15*th*.—Passed by Dhurmpooree, and on to Tolie, a small village in the jungle.

16*th*.—Munawer a town on the river Maan, west of the town is a small temple in a field, some of the pieces of limestone of which it is composed are a mass of shells.

17*th*.—To Dherree a large village on the Ourie river. All about Dherree the country is composed of a Breccia of trap, with some limestone and sandstone pieces amongst it, some of them are a little rolled but the most are angular. From Mundlaisir to Dherree, all the country is of trap with no jungle, except a small babool scrub and uninteresting.

18*th*.—To Bang, the Breccia continuing most of the way. Some three or four miles from Baug, sandstone is seen in the bed of a nullah, but the high land about is all trap. About two miles out of Baug, the sandstone commences, it is of a light pink colour easily broken up, and the plain is covered with silicious sand from it; in the bed of the stream, we found pieces of black shale which on exposure to strong heat, bubble up into a slag, and on being left in a wood fire for some hours, turn light grey; we could trace no vegetable impressions in them.

19*th*.—To see the iron ore, first proceeded east of the town some four miles, and came to the last works which were carried on some 16 or 20 years ago. The ore lies in the body of a small hill, and has been most extensively quarried, it is a light yellow ore like that of Nandia, near Burwah, and of Nancoot, but in far greater masses than any I have seen at those places, and has been most extensively worked. The deepest mine we went into measured 48 feet from top to bottom, and was about double that width. Quite close to the ore is a large hill of limestone, but so hard and deep blue that I was

certain it was a trap, or metamorphic stone; on burning, however, it turned out a beautiful lime. Near the town are numbers of small pits and burrows, but no large mines like those to the east.

20*th.*—In the morning went to see the caves, the figures in them very fine and imposing, as seen by torch-light, and the situation very lovely; the Baugun river seems to have no single fall, but a continued rapid descent; the cliff in which the caves are situated consists of a mass of sandstones of all colours, sloping up to the N. E. at a slight angle, and topped with a very hard and white friable limestone, in which we found some shell impressions. About five miles from Baug to the east of the Noonsee Road, is a quarry of white sandstone, an even bedded and soft stone, which is still carried a long distance for building purposes, it seems to be near the bottom of the mass of sandstone. In the evening rode out towards Cheeklee and Rajpoor, some 5 or 6 miles.

21*st.*—This morning to the village of Auggur, N. E. of Baug, where iron has been very largely worked. Ore in great abundance, also the hard grey limestone. All about Baug E. and west is a bed of shales, which seem to be nearly vertical, dipping to the S. or S. W. at a very steep angle, the ore seems generally to be in them.

22*nd.*—Rode out along the road to Cheeklee, west of Baug to the village of Mogra, about ten miles distant. At about 6 miles, found trap covering sandstone, up to that, the country having shewn nearly alternately sandstones and limestones. In the afternoon leaving Mogra, we went nearly north to the village of Kharrwa, and from that E. to Baug seeing limestones and sandstones all the way, except one hill capped with trap.

23*rd.*—Left Baug by the same road as entered it from Dherree but struck off to the N. E. from the second village; soon got into the trap again, with sandstones under it. About half way to Bulwarrie in the Ourie Nulla, near the village of Khojakoa, found a considerable thickness of sandstones, dipping to the North and thickly covered with trap. Near Bulwarrie saw some curious metamorphic rocks, looking rather like granite; at Bulwarrie itself all seemed trap.

24*th.*—Marched to Kutchkonda. Up to half way all seemed trap, but after that we got into the coral limestones, and continued

through them to Kutchkonda. A good deal of stone has been quarried in a superficial way at this place both to the north and east, the quarried stone lies just under trap. In the evening rode East some four miles, to see a fall in the River Maan; the fall is near the village of Neemkhera, and is caused by a barrier of trap, the height from 18 to 20 feet, according to the place it is taken from. A considerable quantity of water was going over it in four streams. Between the fall and Kutchkonda, the river exposes a considerable thickness of crystalline limestones and shales in thin beds, dipping considerably to the N. E. and at Kutchkonda is a gritty shale, used by the barbers of all Nimar as a honestone.

25*th.*—Viâ Cheerakhan, (meaning "cut-stone quarry") to Deora. The former is evidently the place from whence cut-stone went to Mandoo, and is so remembered traditionally. There are two small mosques in the Mandoo style, built by the workmen of the olden days. The quarries lie on the top of low hills, and have been quarried along the top in a layer of about four or five feet, no where apparently deeper. The rock is here not covered with trap. The amount of stone that has been quarried is very large. From Cheerakhan to Deora, the country is all limestone. A mile or two out of Deora, passed what appeared to be a fossil trunk of a tree lying on the road; and about half a mile out, a bed of thin shales dipping to the north. The thick limestone seems nearly horizontal. At Deora found that the people had collected a good many fossils.

26*th.*—In the morning for several hours fossil hunting; found some new ones, and saw a bank that appeared to contain more, and in which many were found in the evening. The fossil bed is composed of a clay, usually yellow, with some red and white veins in it, and with about a foot of compact limestone over it, the bed is intersected by a stream, and shows best near the village of Odeypoor: near it is also a bed of very friable limestone, looking exactly like that over the caves at Baug, but containing Echini and some small shells.

27*th.*—In the morning marched east, some six miles to the Village of Putlowed, a deserted site on high ground near a small stream. The bed of the stream was all trap, but a number of echini were distributed in the gravel of its bed, showing that it must pass

through a fossil deposit. From thence to Baccaneer south six miles, and so into Mundlaiser."

From these details it will be evident that to Captain Keatinge alone is due the merit of having first distinguished these fossils as cretaceous, and to him also belongs the merit of having most zealously and under considerable difficulties, collected a very tolerable series of them.

I have taken this opportunity of recording the facts above given, more especially because in the last number of the Journal of the Bombay Branch of the Royal Asiatic Society, there is a notice regarding some fossils from the same locality, in which the discovery of these most interesting fossils, and their identification as cretaceous, is not fully assigned to Captain Keatinge. And I desire to reclaim for that most active and enlightened officer, the fullest award of credit which his exertions deserve. I do this the more anxiously also, because unexpected circumstances had prevented our doing so at the earliest opportunity, as intended, so long since as May last, the last of the fossils having only reached me a few days previously.

I shall not here discuss the conclusions arrived at by Dr. Carter in the notice referred to,* that these beds are truly neocomien, because I think we have not got any sufficient data to reason upon, I feel confident that the hasty reference of any group of rocks, to some acknowledged European *subdivision* based upon the occurrence of 3 or 4 ill-preserved and ill-identified fossils is both unphilosophical and injurious. The evidence here is abundantly good to say that these rocks represent the cretaceous era, but altogether insufficient to enable one to refer them to any subdivision of that great series.

Reserving, as before, the detailed specific description of these fossils, a generic summary is here given of the number, &c.

Summary of Fossils collected at Baug by Captain Keatinge.

Corallines	4 or 5 species	Species.
Echinodermata.	Cidaris,.....	1
	Echinus, (species)	1
	Brissus, ...	2 or 3

* Journal Bombay Asiatic Society, No. XX. July 1857, page 621.

	Cyphosoma,	2
Mollusca.	Acephala Pholadomya,	1
	Venus,	1
	Cardium,	4
	„ *altum. Sow; hillanum, or very closely allied and two others.*	
	Arca,	1
	Modiola,	1
	Mytilus,	1
	typicus, Forbes.	
	Pecten (Janina)	3
	P. (5. *costatus* common.)	
	Plicatula,	1
	Inoceramus,	1
	Terebratula,	1
Gasteropoda.	Rhynconella,	1
	Natica,	1
	Turritella,	1
	Cerithium,	1
	Triton,	1
	Voluta,	2
Cephalopoda.		
	Ammonites of the *Rhotomagensis* Section,	2

I had hoped to have procured during the past summer an extended series of fossils from this locality, and with a view of having it thoroughly examined, Mr. Wm. Theobald, Junr. was deputed to remain in that district, after his field work of last season had been concluded in the Nerbudda Valley. But the very disturbed state of all the country in that neighbourhood has rendered it impossible to carry out these views. Mr. Theobald, after considerable risk has escaped unhurt, but the examination of the Bagh country, must be deferred to a more favourable opportunity.

I would merely add that a brief notice of the discovery of the fossils, was communicated to the Madras Literary Society, on February 12th, 1857, and published in their Journal No. 2, New Series, and also that I took the opportunity of a brief communication on some points of Indian Geology, made to the British Association for

Advancement of Science, at their meeting in Dublin during the past year, to place on record, the claims of Captain Keatinge as the first who had made out these fossils.*

Library.

The following additions have been made to the Library during the months of December 1857 and January, 1858.

Presented.

Selections from the Records of the Government of Madras the following Nos.—By the Government of Madras.

1854.

No. 1. Report on the Navigation of the Godavery.
3. Ditto on the Proposed abolition of the Madras Mint.
4. Ditto on the Paumban Channel.
8. Proposed plan for the Revenue Assessment of Kurnool, 1843.

1855.

4. Major Maitlaard's School for the instruction of the Artificers and Pupils at the Gun Carriage Manufactory.
7. Ditto on the Civil Dispensaries, 1853.
12. Reduction on the Revenue Assessment in North Arcot.
14. Report on the Medical Topography of the South Western Political Districts.
17. Ditto on Public Instruction in the Madras Presidency for 1854-55.
19. Ditto on Ports and Harbours of the Northern Circars.
20. Ditto on Vaccination in Madras, 1854.
21. Ditto on Civil Dispensaries, 1854.
22. Papers relating to the Revision of Land Revenue Assessment in South Arcot.
23. Reports on the Fibres of Southern India.
24. Ditto on the Disturbances in Purla Kimedy, Vizagapatam and Goomsoor in 1832-36, 2 Vols.
26. Papers relating to the establishment of Village Vernacular Schools in the Sub-Division of Rajamundry.
27. Report relating to the Budget of 1854-55.
28. Ditto ditto of Public Works. for 1855-56.
29. Replies to the collective Memorandum on Public Works in the Madras Presidency.

* An abstract of this communication was republished in the Edinburgh New Phil. Journal, No. 12, New Series, page 320.

30. Report on District Roads, for 1854.
31. Papers relating to the commutation rates of the Madras Presidency.
32. Report of a Committee on a plan for cleansing the drains of Black Town.

32*a* or 33 Ditto of Agricultural Exhibitions in the Provinces in 1856.

33. Report on Vaccination for 1855.
34. Ditto on Civil Dispensaries for 1855. 2 Copies.
37. Correspondence on the scale of Passenger Fares and Goods Tariff for the Madras Railway, Parts I. and II. in one Vol.
38. Papers relating to the Budget of Public Works for 1856-57.
41. Report on Grants-in-aid of Schools unconnected with Government
42. Ditto on Vaccination for 1856.
43. Correspondence on the scale of Passenger Fares and Goods, Tariff for the Madras Railway, Vol. II.

A Map of the Country from Calcutta to Lahore shewing the route of the Rail and the Grand Trunk Road.—By C. Joseph, Esq.

Report of the Grant Medical College for the session 1856-57.—By the Principal of the College.

Selections from the Records of the Government of India, No. XXIV. Report on the Guicowar's Hospital.—Notices on Karen Nee.—Jubbulpore School of Industry—Statement of Criminals disposed of by the Thuggee Department—and Survey of the Andamans.—By the Government of India.

Nabâ Prabundhû Sarâ, or Moral and Entertaining Essays in Bengali, for the use of Colleges and Schools in Bengal, by Mohendrânâth Roy, 12mo. Calcutta.—By the Author.

Selections from the Bengali Poets, Part II. 12mo. compiled by ditto.—By the Same.

Half-yearly Report of the Committee to the Bengal Chamber of Commerce, Calcutta, 31st October, 1857.—By the Chamber of Commerce.

The Journal of the Bombay Branch of the Royal Asiatic Society, No. XX. July, 1857.—By the Bombay Asiatic Society.

Journal Asiatique, Nos. 36, 37, and 38, 1857.—By the Royal Asiatic Society of Paris.

Gelehrte Anzeigen, Nos. 38 and 39.—By the Royal Academy of Science at Munich.

Abhandlungen, der Historischen classe, Band VII. Abth. 2.—By the Same.

——————— der Mathematisch-Physikalischen classe, Band VII, Abth. 2.—By the Same.

——————— für die kunde des Morgenlandes, Von Dr. F. Windeschmann. 1 Band, No. 1, *Liepzig, pamphlet.*—By the Same.

Pflagraf Rupert der Cavalier, *Munich, pamphlet.*—By the Same.

Die Classischen studien und ihre Gegner, *Munich, pamphlet.*—By the Same.

Ueber das Klima von Munchen, *pamphlet.*—By the Same.

Transactions of the Royal Society of Edinburgh, Vol. XV.—By the Society.

Address delivered at the Anniversary Meeting of the Geological Society of London, on the 20th February, 1857. By the President, Col. Portlock.—By the Author.

The Calcutta Review, No. 63.—By the Proprietors.

The Oriental Christian Spectator for Nov. and Dec. 1857.—By the Editors.

The Calcutta Christian Observer for December, 1857 and January, 1858.—By the Editors.

The Oriental Baptist for ditto ditto.—By the Editor.

The Mutinies, the Government, and the People by a Hindu, *pamphlet.* —By the Author.

The Quarterly Journal of the Geological Society, No. 52, November, 1857.—By the Society.

Calcutta Monthly Review, Vol. I. No. I.—By the Editor.

Discours on Hindoostan, by Garcin de Tassy.—By the Author.

Meteorological Tables of Hobert Town for October and November, 1857. —By the Observatory in Hobert Town.

Vividhártha Suñgrahá, Nos. 43 and 44.—By Babu Rajendralal Mitter.

Exchanged.

The Athenæum for September and October, 1857.

The London, Edinburgh and Dublin Philosophical Magazine, Nos. 93 and 94 for October and November, 1857.

Annalen der Chemie und Pharmacie for August and September, 1857.

Purchased.

R. Jehuda Ben Koreisch Tiharetensis Africani ad synagogam judæorum civitatis Fez Epistola de studii Targum utilitate at de linguæ, &c. J. J. L. Bargès, *Paris,* 1857, *pamphlet.*

Le Bouddha et le Bouddhisme par C. Schœbel, *Paris,* 1857, *pamphlet.*

Max Muller's Rig-Veda, Part III. 4to. *Liepzig.*

American Journal of Science and Arts, Nos. 71 and 72, Vol. XXIV.

Annaire des Deux Mondes, VII. 1856-1857.

Annals and Magazine of Natural History for Oct. and Nov. 1857.

Annales des Sciences Naturelles, No. 6, Tome VI. and No. 1, Tome VII.

Edinburgh Review, No. 216 for October, 1857.

Literary Gazette, Nos. 2122 to 2130.

Journal des Savants, Sept. 1857.

Comptes Rendus, Nos. 9 to 15, 1857.

Revue des deux Mondes, 15th September, 1st and 15th October and 1st November, 1857.

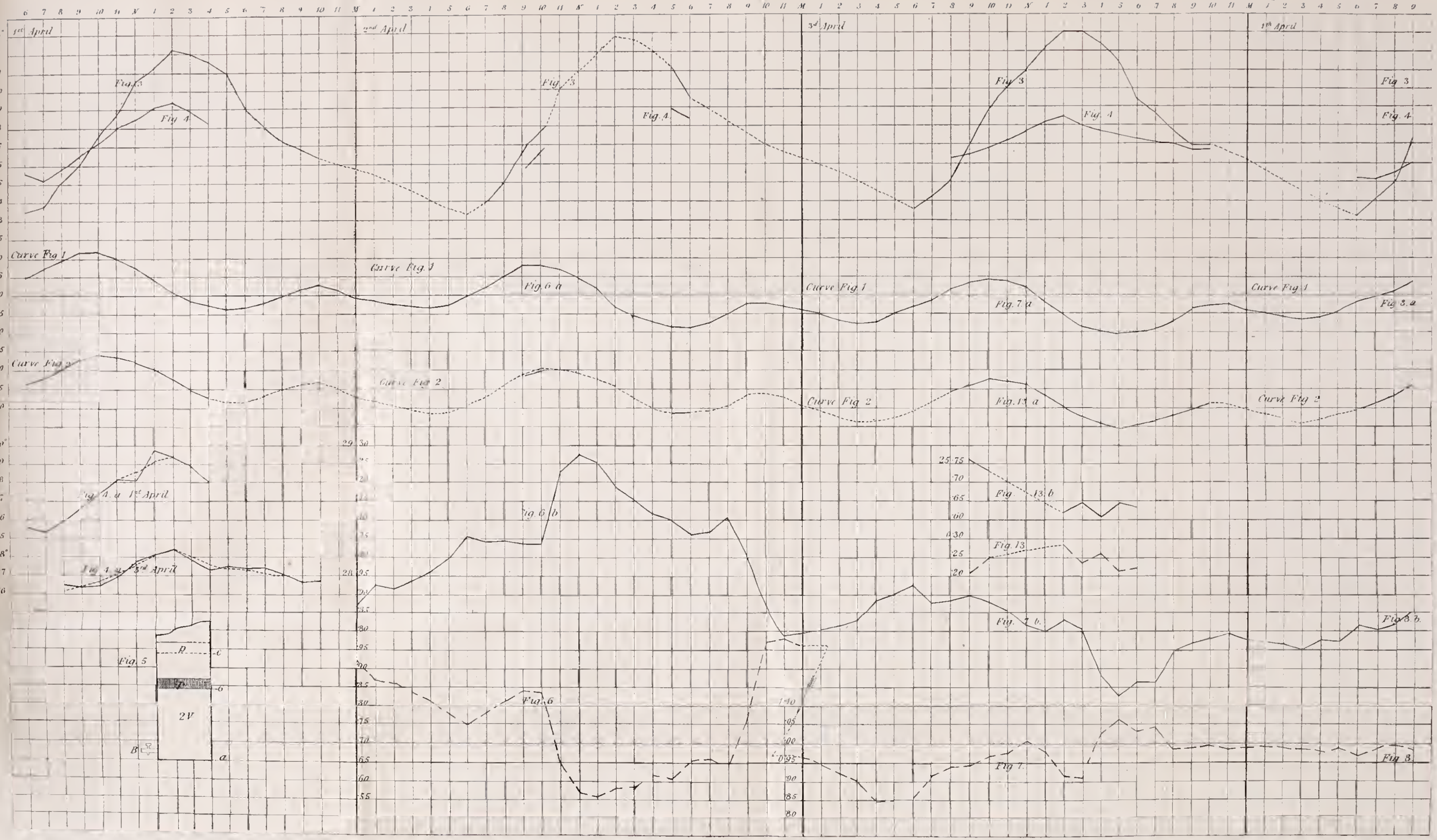
Revue et Magasin de Zoologie, Nos. 8 and 9, 1857.

Natural History Review, No. 4, October, 1857.

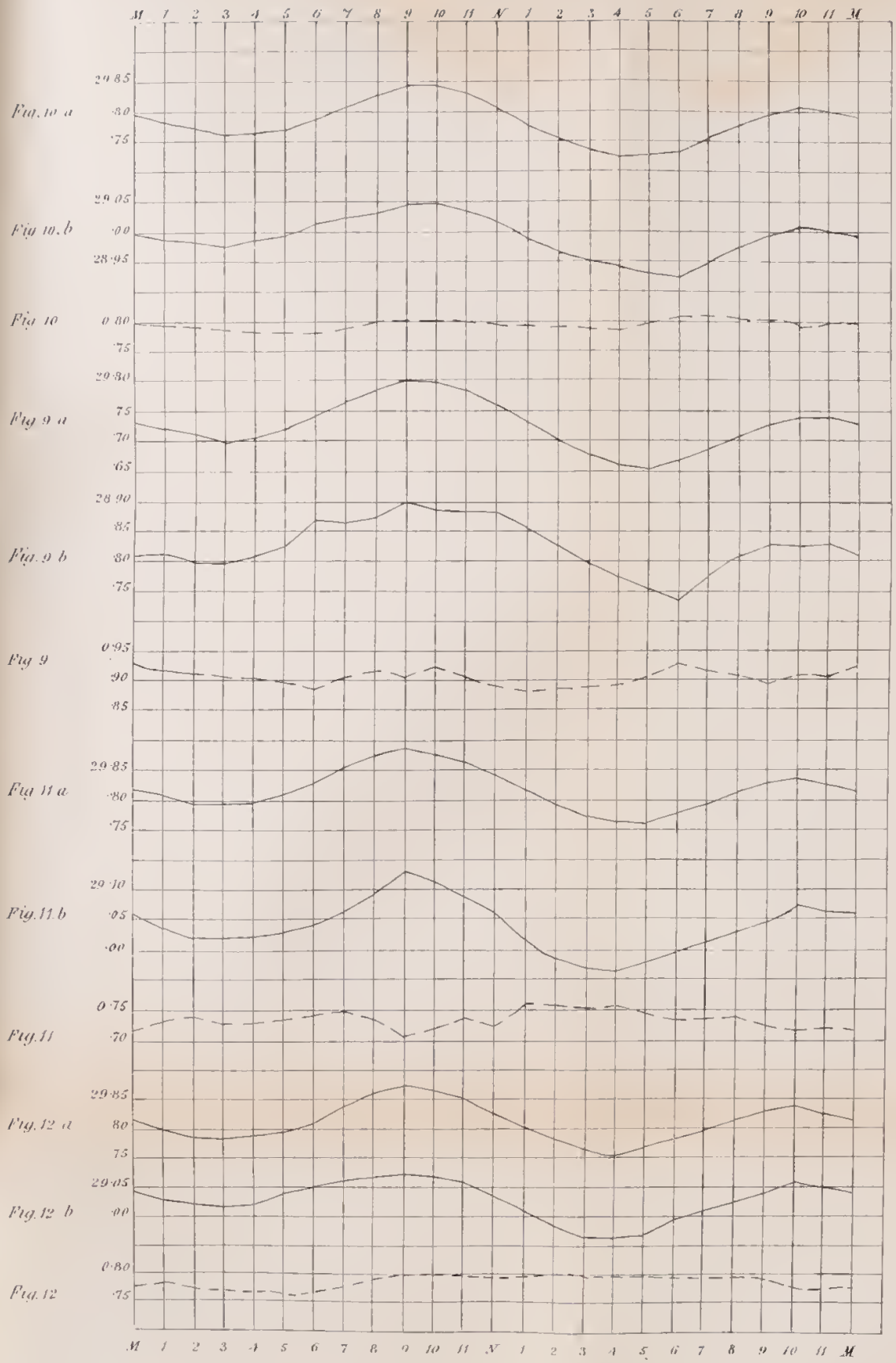
Quarterly Review, No. 204, October, 1857.

GOURDA'S BYSACK.

Feb. 1858. *Librarian and Asst. Secy.*



LITHOG BY H M SMITH, SURV GENL'S OFFICE CALCUTTA, JANUARY 1858



(THEG BY H. M. SMITH, SURVEYOR GENL'S OFFICE, CALCUTTA JANUARY 1859

EXPLANATION OF PLATES.

Plate I.

Curve Fig. 1 (including Figs. 6 a, 7 a, 8 a,). Hourly barometrical pressures at Calcutta on 1st, 2nd, 3rd, 4th April, 1856.

Curve Fig. 2 (including Fig. 13 a,). Hourly barometrical pressures on the Hill.

Fig. 3. Hourly mean temperatures of the stations.

Fig. 4. Real mean temperatures, corrected.

Fig. 4 a. Real mean temperatures, uncorrected.

Fig. 5. Vide page 37.

Figs. 6, 7, 8, 13. Hourly tensions of moisture on 2nd, 3rd, 4th April at Calcutta and on 3rd on the Hill.

Figs. 6 a, 7 a, 8 a, 13 a. Hourly barometrical pressures on 2nd, 3rd, 4th April at Calcutta, and on 3rd April on the Hill.

Figs. 6 b, 7 b, 8 b, 13 b. Hourly pressures of dry air on 2nd, 3rd, 4th April at Calcutta, and on 3rd on the Hill.

Plate II.

Figs. 9, 9 a, 9 b. Mean hourly tensions of moisture, hourly barometrical pressures and hourly pressures of dry air for April, 1856, at Calcutta.

Figs. 10, 10 a, 10 b. The same for the whole year, 1856.

Figs. 11, 11 a, 11 b. The same for April, 1850, at Bombay.

Figs. 12, 12 a, 12 b. The same for the whole year, 1850, at Bombay.

ERRATA.

Page 5, Table I. 3rd April, Temple, Bar. 9 A. M. Instead of 25.916 read 25.961

Page 16. Note. Instead of *K. C.* read *L. C.*

Page 17, line 9 from above. Instead of *difficulties,*—read *difficulties ;*

Page 24, line 6 from above. Instead of *pressure* read *pressures.*

Page 24, line 11 from below. Instead of

$$\frac{a + t''}{a + t'} \textit{ read } \frac{a + t'}{a + t''}$$

Page 26, line 5 from below. Instead of *weight,* read *weight, expressed in English Inches.*

Page 43, line 1 from above. Instead of *climates ;* read *climates.*

Page 43, line 3 from below. Instead of *amount of dew* read *amount of precipitation by dew.*

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January, 1858.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the Sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Fahr.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	°	°	°	°
1	30.090	30.181	30.018	0.163	68.5	77.6	60.6	17.0
2	.025	.107	29.940	.167	68.1	77.4	60.8	16.6
3	*Sunday.*							
4	.011	.111	.948	.163	67.0	76.6	59.6	17.0
5	29.986	.062	.932	.130	67.7	78.5	60.4	18.1
6	.998	.071	.938	.133	66.1	76.7	58.6	18.1
7	30.009	.114	.942	.172	66.6	77.2	57.6	19.6
8	29.992	.084	.936	.148	66.6	77.7	58.4	19.3
9	.971	.063	.917	.146	65.9	76.6	56.6	20.0
10	*Sunday.*							
11	.957	.031	.881	.150	69.2	80.6	60.8	19.8
12	.936	.019	.878	.141	67.6	78.1	59.4	18.7
13	.966	.064	.912	.152	65.2	75.4	56.8	18.6
14	.966	.051	.896	.155	64.9	76.6	56.6	20.0
15	.983	.084	.911	.173	66.2	78.4	56.2	22.2
16	.988	.081	.943	.138	66.7	79.2	57.5	21.7
17	*Sunday.*							
18	.922	.005	.865	.140	72.2	84.0	63.8	20.2
19	.910	29.984	.856	.128	72.9	83.8	65.0	18.8
20	.958	30.038	.886	.152	69.4	75.4	64.6	10.8
21	.873	29.955	.812	.143	69.9	79.2	64.2	15.0
22	.879	.940	.841	.099	66.7	74.8	61.4	13.4
23	.990	30.092	.902	.190	64.8	75.4	56.4	19.0
24	*Sunday.*							
25	30.040	.111	.978	.133	68.1	79.3	58.4	20.9
26	.062	.138	.976	.162	69.9	80.2	61.0	19.2
27	.075	.164	30.010	.154	69.1	79.2	62.0	17.2
28	.073	.140	.019	.121	70.3	79.4	62.4	17.0
29	.064	.136	.009	.127	71.3	79.6	65.2	14.4
30	.112	.208	.057	.151	69.4	77.6	63.0	14.6
31	*Sunday.*							

The Mean height of the Barometer, as likewise the Mean Dry and Wet Bulb Thermometers are derived from the twenty-four hourly observations made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January, 1858.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon. *(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	°	°	°	°	Inches.	T. gr.	T. gr.	
1	63.1	5.4	60.4	8.1	0.530	5.85	1.80	0.77
2	62.4	5.7	59.0	9.1	.506	.59	.96	.74
3	*Sunday.*							
4	61.6	5.4	58.4	8.6	.496	.48	.82	.75
5	61.5	6.2	57.8	9.9	.486	.37	2.09	.72
6	59.5	6.6	55.5	10.6	.450	4.99	.11	.70
7	60.5	6.1	56.8	9.8	.470	5.20	.01	.72
8	60.2	6.4	56.4	10.2	.464	.14	.07	.71
9	59.3	6.6	55.3	10.6	.447	4.96	.10	.70
10	*Sunday.*							
11	63.8	5.4	61.1	8.1	.543	5.98	1.83	.77
12	60.6	7.0	56 4	11.2	.464	.12	2.32	.69
13	56.9	8.3	51.9	13.3	.398	4.43	.48	.64
14	57.1	7.8	52.4	12.5	.405	.50	.35	.66
15	58.5	7.7	53 9	12.3	.426	.73	.39	.66
16	59.2	7.5	54.7	12.0	.438	.85	.38	.67
17	*Sunday.*							
18	66.1	6.1	63 0	9 2	.578	6.33	.22	.74
19	66.6	6.3	63.4	9.5	.586	.40	.33	.73
20	63.9	5.5	61.1	8.3	.543	5.98	1.88	.76
21	62.8	7.1	59.2	10.7	.509	.60	2.38	.70
22	58.4	8.3	53.4	13 3	.419	4.65	.58	.64
23	56.8	8.0	52.0	12.8	.400	.44	.39	.65
24	*Sunday.*							
25	61.7	6.4	57.9	10.2	.488	5.38	.17	.71
26	63.0	6.9	59.5	10.4	.515	.66	.32	.71
27	63.5	5.6	60.7	8.4	.536	.90	1.88	.76
28	63.9	6.4	60.7	9.6	.536	.88	2.20	.73
29	65.4	5.9	62.4	8.9	.567	6.22	.11	.75
30	61.2	8.2	57.1	12.3	.475	5.23	.63	.67
31	*Sunday.*							

All the Hygrometrical elements are computed by the Greenwich constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January, 1858.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Fahr.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	°	°	°	°
Mid-night.	29.994	30.109	29.861	0.248	64.1	69.0	59.3	9.7
1	.989	.102	.859	.243	63.5	68.1	58.5	9.6
2	.977	.095	.845	.250	62.9	67.8	57.8	10.0
3	.969	.089	.841	.248	62.3	67.5	57.1	10.4
4	.973	.080	.865	.215	61.5	67.0	56.6	10.4
5	.976	.087	.846	.241	61.3	66.0	56.7	9.3
6	.993	.107	.863	.244	60.7	65.5	56.6	8.9
7	30.015	.125	.872	.253	60.4	65.4	56.2	9.2
8	.046	.152	.908	.244	62.3	68.2	58.5	9.7
9	.071	.195	.930	.265	66.3	69.8	63.2	6.6
10	.077	.208	.940	.268	69.8	73.1	66.8	6.3
11	.056	.189	.923	.266	73.2	76.8	70.2	6.6
Noon.	.023	.170	.903	.267	75.4	80.1	72.2	7.9
1	29.990	.123	.873	.250	77.1	82.2	73.8	8.4
2	.963	.095	.838	.257	77.8	83.4	73.6	9.8
3	.943	.072	.824	.248	77.8	84.0	72.0	12.0
4	.935	.062	.812	.250	76.2	82.2	72.4	9.8
5	.942	.062	.822	.240	74.4	80.6	70.4	10.2
6	.951	.075	.834	.241	71.6	77.2	68.0	9.2
7	.968	.095	.825	.270	69.5	75.1	65.8	9.3
8	.988	.110	.846	.264	67.8	73.2	64.0	9.2
9	30.001	.127	.858	.269	66.5	72.6	62.4	10.2
10	.007	.149	.864	.285	65.5	72.0	61.2	10.8
11	.002	.144	.865	.279	64.8	71.6	60.4	11.2

The Mean height of the Barometer, as likewise the Mean Dry and Wet Bulb Thermometers are derived from the observations made at the several hour during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January, 1858.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon. *(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic Force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	60.3	3.8	57.6	6.5	0.483	5.36	1.31	0.80
1	60.0	3.5	57.5	6.0	.481	.36	.19	.82
2	59.6	3.3	57.3	5.6	.478	.33	.10	.83
3	59.2	3.1	57.0	5.3	.473	.29	.02	.84
4	58.5	3.0	56.4	5.1	.464	.19	0.97	.84
5	58.4	2.9	56.1	5.2	.459	.15	.97	.84
6	57.8	2.9	55.5	5.2	.450	.05	.95	.84
7	57.5	2.9	55.2	5.2	.445	.00	.95	.84
8	58.9	3.4	56.5	5.8	.465	.20	1.11	.82
9	60.6	5.7	57.2	9.1	.476	.27	.88	.74
10	61.8	8.0	57.8	12.0	.486	.35	2.60	.67
11	62.8	10.4	57.6	15.6	.483	.27	3.55	.60
Noon.	63.8	11.6	58.0	17.4	.489	.32	4.11	.56
1	64.4	12.7	58.0	19.1	.489	.30	.62	.53
2	64.8	13.0	58.3	19.5	.494	.34	.79	.53
3	64.8	13.0	58.3	19.5	.494	.34	.79	.53
4	64.1	12.1	58.0	18.2	.489	.31	.35	.55
5	64.0	10.4	58.8	15.6	.503	.47	3.68	.60
6	64.1	7.5	60.3	11.3	.528	.80	2.60	.69
7	63.1	6.4	59.9	9.6	.521	.73	.15	.73
8	62.2	5.6	58.8	9.0	.503	.55	1.93	.74
9	61.7	4.8	58.8	7.7	.503	.56	.63	.77
10	61.1	4.4	58.5	7.0	.498	.52	.46	.79
11	60.5	4.3	57.9	6.9	.488	.41	.42	.79

All the Hygrometrical elements are computed by the Greenwich constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January, 1858.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches.		
1	129.8	..	N. W.	Cloudless: also slightly foggy between Midnight and 6 A. M.
2	129.0	..	W. & N. E.	Cloudless: also foggy between 9 P. M. and Midnight.
3	*Sunday.*			
4	131.0	..	W. & S. W.	Cloudless: also foggy between Midnight and 7 A. M. also the same between 8 P. M. and Midnight.
5	135.0	..	S. W. & N. W.	Cloudless.
6	132.0	..	Calm & N. W. & W.	Cloudless.
7	132.0	..	N. W. & N. E. & N.	Cloudless till 11 A. M. Scatd. ⌒i and ⌣i till 3 P. M. cloudless afterwards.
8	134.0	..	N. W. & N.	Cloudless.
9	130.0	..	N. W. & N. E.	Cloudless, also foggy between 9 & 11 P. M.
10	*Sunday.*			
11	136.2	..	S. W. & Calm.	Cloudless.
12	135.0	..	N. W. & Calm.	Cloudless.
13	135.0	..	N. W. & W.	Cloudless till 11 A. M. Scatd. \i & ⌣i till 6 P. M. cloudless afterwards.
14	134.0	..	S. W. & Calm & W.	Cloudless till 6 A. M. Scatd. ⌣i till 5 P. M. cloudless afterwards.
15	136.4	..	W. & S. W. & N. W.	Cloudless till 5 A. M. Scatd. ⌣i till 3 P. M. cloudless afterwards.
16	133.4	..	Calm & W.	Cloudless till 4 A. M. Scatd. ⌣i till 5 P. M. cloudless afterwards: also foggy between 9 & 11 P. M.
17	*Sunday.*			
18	139.0	..	S. & S. W.	Cloudless: also foggy between 4 & 8 A. M.
19	134.0	..	S. W. & S.	Cloudless till 8 P. M. cloudy afterwards; also slightly drizzling between 9 & 10 P. M.
20	..	..	Variable.	Cloudy; likewise slightly raining between 4 & 5 P. M. & also between 8 & 9 P. M.
21	132.0	0.07	S. W.	Cloudy; also slightly drizzling at 5 P. M.
22	128.5	..	N. W.	Cloudless.
23	134.0	..	Calm & N. E. & E.	Cloudless; also slightly foggy between 7 & 11 P. M.
24	*Sunday.*			
25	136.0	..	S.	Cloudless.

\i Cirri, ⌣i Cirro strati, ⌒i Cumuli, ⌒i Cumulo strati, ⌣i Nimbi, —i Strati ⌣i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January, 1858.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches.		
26	134.0	..	S. E. & N. E.	Cloudless till 5 A. M. Scatd. ⌣i till 10 A. M. cloudless till 6 P. M. Scatd. ⌣i afterwards.
27	128.0	..	N. E. & N. W.	Scatd. ⌣i.
28	125.4	..	N. W. & N. & N. E.	Scatd. ⌣i & ∩i.
29	133.0	..	W. & N. W. & Calm.	Scatd. ⌣i till 5 A. M. cloudy till 9 A. M. Scatd. ⌣i & ∩i till 6 P. M. cloudless afterwards.
30	134.5	..	N. W. & W. & E.	Cloudless.
31	*Sunday.*			

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January, 1858.

Monthly Results.

	Inches.
Mean height of the Barometer for the month, ...	29.994
Max. height of the Barometer occurred at 10 A. M. on the 30th, ..	30.208
Min. height of the Barometer occurred at 4 P. M. on the 21st, ..	29.812
Extreme range of the Barometer during the month, ...	0.396
Mean of the Daily Max. Pressures, ...	30.078
Ditto ditto Min. ditto, ...	29.931
Mean Daily range of the Barometer during the month, ...	0.147

	°
Mean Dry Bulb Thermometer for the month, ...	68.1
Max. Temperature occurred at 3 P. M. on the 18th, ...	84.0
Min. Temperature occurred at 7 A. M. on the 15th, ...	56.2
Extreme range of the Temperature during the month, ...	27.8
Mean of the Daily Max. Temperature, ...	78.3
Ditto ditto Min. ditto, ...	60.3
Mean Daily range of the Temperature during the month, ..	18.0

	°
Mean Wet Bulb Thermometer for the month, ...	61.4
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer, ..	6.7
Computed Mean Dew-point for the month, ...	57.4
Mean Dry Bulb Thermometer above computed mean Dew-point, ..	10.7
	Inches.
Mean Elastic force of Vapour for the month, ...	0.480

	Troy grains.
Mean Weight of Vapour for the month, ...	5.29
Additional Weight of Vapour required for complete saturation, ..	2.26
Mean degree of humidity for the month, complete saturation being unity,	0.70

	Inches.
Rained 3 days, Max. fall of rain during 24 hours, ...	0.07
Total amount of rain during the month, ...	0.07
Prevailing direction of the Wind, ...	N. W. & S. W. & W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January, 1858.

Monthly Results.

Table showing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour when any particular wind was blowing it rained.

Hour.	N.	Rain on.	N. E.	Rain on.	E.	Rain on.	S. E.	Rain on.	S.	Rain on.	S. W.	Rain on.	W.	Rain on.	N. W.	Rain on.	Calm.	Rain on.	Missed.
							No. of days.												
Midnight.	1		3				1		3		3		2		4		9		
1	1		2		1		1		3		4		3		4		7		
2	1		1		1				3		4		4		4		6		2
3	1		2				1		3		4		3		5		7		
4	1		2				1		2		3		3		5		7		2
5	1		2				1		3		3		5		3		6		2
6	1		2		1				3		3		5		6		5		
7	2		3		2				3		3		2		8		3		
8	3		3		3		1		3		2		1		8		2		
9	2		5		2		1		1		4		1		9		1		
10	3		5				2		1		1		4		10				
11	4		4				1		3		1		5		8				
Noon.	2		3		1		1		1		3		8		7				
1	3		1		1				2		4		6		9				
2	1		1				2				7		5		10				
3	1						1		1		5		7		11				
4	2				1		1		1		5		7		9				
5	3						1		2		4	1	5	1	10		1		
6	2		3				1		2		5		3		8		2		
7	1		3		2		1		2		6		3		5		3		
8			3		2		1		3		5		2		5		5		
9			3		2				3		6	1	2		5		5		
10			3		2		1	1	3		5		2		5		5		
11			3		2		1		3		5		2		5		5		

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